CONTRACT N40085-09-R-0210

NAVFAC SPECIFICATION
NO. 05-09-0210

MULTIPLE AWARD CONSTRUCTION CONTRACT (MACC)

AT THE

MARINE CORPS BASE, CAMP LEJEUNE, NORTH CAROLINA
AND/OR
MARINE CORPS AIR STATION, NEW RIVER, JACKSONVILLE, NORTH CAROLINA
AND/OR
NAVAL HOSPITAL, MARINE CORPS BASE, CAMP LEJEUNE
AND/OR
MARINE CORPS AIR STATION, CHERRY POINT, NORTH CAROLINA
AND/OR
OTHER MILITARY AND GOVERNMENT INSTALLATIONS/SITES IN NORTH CAROLINA

DESIGN BY:

Public Works Design Division
Camp Lejeune, NC

SPECIFICATION PREPARED BY:

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05090210

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SECTION 01 11 00

SUMMARY OF WORK

09/08

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The work includes:

GENERAL:
The resulting contract(s) will provide a wide range of general construction services including new construction, demolition, repair, total/partial interior/exterior alteration/renovation of buildings, systems and infrastructure and may include civil, structural, mechanical, electrical, communication systems; installation of new or extensions to existing high voltage electrical distribution systems, extensions to the existing high pressure steam distribution systems, extensions to the potable water distribution systems, extensions to the sanitary sewer systems, additional storm water control systems; painting, removal of asbestos materials and lead paint, and incidental related work. Types of buildings and facilities include administrative, industrial, warehouses, maintenance, communications, schools/training/education, personnel support, recreational, food services, training areas/ranges, roads, etc. All work under this RFP will be performed at Marine Corps Base Camp Lejeune (including the New River Air Station) and Marine Corps Air Station Cherry Point, North Carolina, and other military and government installations/sites in North Carolina.

PAINTING:
The resulting contract(s) will provide a wide range of general painting services including, but not limited to, interior and/or exterior painting of various buildings, structures, facilities, equipment, miscellaneous apparatus and components, roadway markings, signage, other infrastructure, incidental preparation, repair and/or replacement of interior/exterior surfaces, and interior/exterior repairs. Work may include lead conditions and/or require lead or asbestos abatement. Types of buildings and facilities include administrative, industrial, warehouses, maintenance, communications, schools/training/education, personnel support, recreational, food services, training areas/ranges, roads, etc.

MECHANICAL:
The requirements cover a broad range of mechanical construction services including, but not limited to, demolition, repair, replacement, modification, and new installation of various mechanical systems including HVAC, boilers, high pressure steam distribution, electrical distribution, motors, generators, potable water distribution, sanitary sewer, storm water control, communications, and incidental work such as general construction, specialty trades, and removal of asbestos or lead contaminated materials. The source selection evaluation criteria require offerors to demonstrate experience in demolition, repair, replacement, modification, and new installation of various mechanical systems. Types of buildings and facilities include administrative, industrial, warehouses, maintenance,

communications, schools/training/education, personnel support, recreational, food services, training areas/ranges, roads, etc.

ELECTRICAL:
The resulting contract(s) will cover a broad range of electrical construction services including, but not limited to: demolition, repair, replacement, modification, and new installation of various electrical systems including but not limited to: sub-stations, high voltage power distribution systems, transformers, generators, uninterruptable power systems, automatic transfer switches, lightning protection, emergency lighting, task lighting, exterior lighting, interior lighting, building branch circuit reconfigurations, telecommunication systems, fire alarm systems, mass notification systems, providing power for various mechanical systems including HVAC, pumps, controls, etc., and any other incidental work such as general construction, specialty trades and removal of asbestos or lead contaminated materials. Potential contractors shall be required to work very closely with other construction trades to insure project completion deadlines are achieved as efficiently as possible. The source selection evaluation criteria require potential contractors to demonstrate experience in demolition, repair, replacement, modification, and new installation of various electrical systems. Types of buildings and facilities include administrative, industrial, warehouses, maintenance, communications, schools/training/education, personnel support, recreational, food services, training areas/ranges, roads, etc.

CIVIL:
The requirements cover a broad range of civil construction services including, but not limited to demolition, repair, replacement, modification and new installation of various civil systems. Specific services include permitting for stormwater, erosion control, wetlands, etc. Stormwater BMP's, raw water and geothermal well connections, surveying, concrete and/or asphalt paving, traffic signaling and signage, pavement marking, traffic studies, railway work, drainage, timber, steel, concrete bridge repair and construction, and earthwork. Within the Base, major emphasis is to be placed on stormwater and erosion control as runoff drains into both SA and SC waters, site soil stabilization will require seeding, planting, sod, etc. Types of infrastructure include administrative, industrial, warehouses, maintenance, communications, school, education, personnel support, recreation, food services, training areas and ranges, retaining walls, roads, fencing, gates, etc.

PAVING:
The resulting contract(s) will provide a wide range of new and repaired bituminous pavement structures, temporary traffic controls, site clearing activities, demolition work for existing site construction, storm drainage work, general site grading and earthwork, placement of pavement markings and traffic control signs, turf establishment work, traffic signal work, minor modifications or repairs to water and sewer distribution, minor utility relocations and modifications. Concrete work may include curb and gutter construction, concrete drainage structures, sidewalks, flumes, concrete pavement repairs and alterations and reasonable size concrete slab construction. Supporting activities of an engineering nature could include surveying, development of traffic control plans, development of storm water, sedimentation and erosion control permits, preparation of preconstruction and post construction drawings, geotechnical site engineering and project record keeping. All work under this RFP will be performed at Marine Corps Air Station Cherry Point, North Carolina and all outlying fields, Marine Corps Base Camp Lejeune (including the New River Air Station), and other military and government installations/sites in

North Carolina.

ROOFING:
The work will include demolition, repair, and replacement of roofing systems (including but not limited to modified bitumen, standing seam metal, shingles, single ply systems) and incidental related work including, but not limited to, painting, asbestos/lead paint abatement, architectural modifications (i.e decking replacement, blocking, etc.) and structural modifications. Typical roofing system (system includes but is not limited to insulation, membrane and penetration flashings, and sheet metal items such as receiver and counter flashings, regets, copings, and roof edge strips) warranties required for new modified bitumen and single ply roofing systems shall be twenty year no dollar limit warranties issued by the roofing membrane manufacturer that provide for replacement or repair of materials and workmanship when the roofing system becomes non watertight or when the system otherwise fails due to defective materials and workmanship, or both. Damage to roofing systems caused by sustained winds having a velocity of 100 mph or less shall be covered by the warranty. Modified bitumen and single ply roofing systems shall be installed by contractors certified or otherwise approved by the roofing membrane manufacturer to install their roofing system(s). Each proposer should provide documentation indicating that they are approved, authorized, or licensed to install modified bitumen and single ply roofing systems. Failure to provide such documentation may result in a technically unacceptable proposal.

1.1.2 Location

The work shall be located at the Marine Corps Base Camp Lejeune (including the New River Air Station) and Marine Corps Air Station Cherry Point, North Carolina, and other military and government installations/sites in North Carolina. The exact location will be indicated by the Contracting Officer.

1.2 PHASED CONSTRUCTION SCHEDULE

Within the overall project schedule, commence and complete the work in phases. Complete each phase of the work within the number of calendar days stated in the following schedule.

a. Scheduled start day: The day designated as the beginning of a particular phase; the number listed is the number of calendar days from the award of contract.

b. Completion day: The day designated as the end of a given phase and the day the work in that phase must be completed; the number listed is the number of calendar days from the award of contract.

c. Schedule:

PHASE	DESCRIPTION	SCHEDULED START DAY	COMPLETION DAY
A	_____	_____	_____
B	_____	_____	_____
C	Completion of remaining work	_____	_____

d. If the work of a particular phase is complete and accepted before

the scheduled completion day, immediately begin work on the subsequent phase unless otherwise restricted.

1.3 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.4 LOCATION OF UNDERGROUND FACILITIES

The Contractor will be responsible for obtaining the services of a professional utility locator to scan the construction site with electromagnetic or sonic equipment, and mark the surface of the ground where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.5 GOVERNMENT-FURNISHED MATERIAL AND EQUIPMENT

Pursuant to Contract Clause "FAR 52.245-2, Government Property (Fixed Price Contracts)" "FAR 52-245-2, Government - Furnished Property (Short Form)", the Government will furnish the following materials and equipment for installation by the Contractor:

DESIGNATION NO.	DESCRIPTION	QUANTITY
_____	_____	_____

1.5.1 Delivery Schedule

Notify the Contracting Officer in writing at least 30 calendar days in advance of the date on which the materials and equipment are required. Pick up materials and equipment no later than 30 calendar days after the required date.

1.6 MERCHANTABLE TIMBER REMOVAL

The Government will have the option to remove merchantable timber from the construction site prior to the Contractor starting his clearing operations. The Contractor shall provide the Government a minimum 3 weeks written notice prior to the start of his clearing operations. The Government will take approximately 2 weeks to remove the merchantable timer, and will leave approximately 2 feet of stump for Contractor removal. Stumps, limbs, and smaller trees shall be left on site for the Contractor to dispose of. Merchantable timber shall remain the property of

the Government.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 12 00

CUTTING AND PATCHING

01/07

PART 1 GENERAL

1.1 CUTTING

Shall be done by sawing along straight lines. The amount cut out shall be the minimum necessary to accommodate the new work. No flame cutting will be permitted without written permission of the Officer in Charge of Construction.

1.2 HOLES

Shall be rotary drilled. The size shall be the minimum necessary to accommodate the new work.

1.3 PATCHING

Shall be done with materials which match the existing in color, quality and surface texture when finished.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 13 00

TRAFFIC SAFETY

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA SA-89-006 (1988) Manual on Uniform Traffic Control Devices for Streets and Highways

1.2 MAINTENANCE FOR TRAFFIC

The existing road or an approved bypass shall be kept open to all traffic while undergoing improvements . The Contractor shall furnish, erect, light, and maintain barricades, warning and informational signs, delineators, and flagmen in accordance FHWA SA-89-006.

1.2.1 TEMPORARY APPROACHES

Temporary approaches or crossings and intersections with trails, roads, streets, residences, and parking lots shall be maintained in a safely passable condition.

1.3 PUBLIC CONVENIENCE AND SAFETY

The Contractor shall at all times so conduct his work as to assure the safety and convenience of the users and of those along the streets and roads and to assure the protection of persons and property.

1.4 WARNING SIGNS

Warning signs shall be erected in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an exist ing road.

1.4.1 INFORMATIONAL SIGNS

The Contractor shall furnish, erect, maintain, and remove, when directed, any informational identification indicated.

1.4.2 CONSTRUCTION WARNING SIGNS

Construction warning signs shall be displayed only when a crew is actually working at the site. "Men Working" or "Flagman" signs shall be removed from view of traffic when not needed.

1.5 TRAFFIC REROUTING PLANS

Traffic rerouting plans shall be submitted for approval seven calendar days before the anticipated rerouting, and shall not be implemented before approval. The Contractor shall erect and remove all detour signs.

1.6 PAINTING -- TEMPORARY AND PERMANENT

Painting on each street or roadway shall begin within 48 hours after pavement is placed and shall be placed continuously during daylight hours, except during rain, until completion. Painting interrupted for rain shall restart during daylight as soon as pavement is dry. Provide temporary painting on all roadways and stress, except where permanent markings can be placed within 48 hours after pavement is placed.

PART 2 PRODUCTS

2.1 Traffic Control Devices

FHWA SA-89-006.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01 14 00

WORK RESTRICTIONS

01/07

PART 1 GENERAL

1.1 SPECIAL SCHEDULING REQUIREMENTS

a. _____ shall be ready for operation as approved by Contracting Officer before work is started on _____ which would interfere with normal operation.

b. Have materials, equipment, and personnel required to perform the work at the site prior to the commencement of the work. Specific items of work to which this requirement applies include:

(1) _____

(2) _____

c. The _____ will remain in operation during the entire construction period. The Contractor shall conduct his operations so as to cause the least possible interference with normal operations of the activity.

d. Permission to interrrupt any Station roads, railroads, and/or utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.

e. The work under this contract requires special attention to the scheduling and conduct of the work in connection with existing operations. Identify on the construction schedule each factor which constitutes a potential interruption to operations.

The following conditions apply:

(1) _____

(2) _____

1.2 CONTRACTOR ACCESS AND USE OF PREMISES

1.2.1 Station Regulations

Ensure that Contractor personnel employed on the Station become familiar with and obey Station regulations. Keep within the limits of the work and avenues of ingress and egress as directed. Do not enter restricted areas unless required to do so and until cleared for such entry. Wear hard hats in designated areas. Do not enter any restricted aras unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

1.2.2 Working Hours

Regular working hours shall consist of an eight and one-half hour period

established by the Contracting Officer, Monday through Friday, excluding Government holidays.

1.2.3 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer approval. Provide written request at least 15 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer.

1.2.4 Occupied and Existing Buildings

The Contractor shall be working in an existing building or around existing buildings which are occupied. Do not enter the buildings without prior approval of the Contracting Officer.

The existing buildings and their contents shall be kept secure at all times. Provide temporary closures as required to maintain security as directed by the Contracting Officer.

Provide dust covers or protective enclosures to protect existing work that remains and Government material located in the building(s) during the construction period.

Relocate movable furniture approximately 6 feet away from the Contractor's working area or as required to perform the work, protect the furniture, and replace the furniture in its original locations upon completion of the work. Leave attached equipment in place, and protect it against damage, or temporarily disconnect, relocate, protect, and reinstall it at the completion of the work.

1.2.5 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in the paragraph "Work Outside Regular Hours."

b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, air conditioning, heating, fire alarm, and compressed air shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

d. Operation of Station Utilities: The Contractor shall not operate nor disturb the setting of control devices in the station utilities system, including water, sewer, electrical, and steam services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the Contracting Officer giving reasonable advance notice when such operation is required.

1.3 SECURITY REQUIREMENTS

Contract Clause "FAR 52.204-2, Security Requirements and Alternate II," "FAC 5252.236-9301, Special Working Conditions and Entry to Work Area," and the following apply:

_____.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 18 00

REQUIREMENTS FOR WORKING FAMILY HOUSING

01/07

PART 1 GENERAL

1.1 Most Units

Most units in this contract will be occupied by families and, therefore, fully furnished. No damage shall occur to furnishings, finishes, or other items during the work.

1.2 EQUIPMENT

Equipment will not be left unattended at any time. All equipment will be removed from any occupied housing unit at the end of each workday.

1.3 CONCURRENT ADDITIONAL CONTRACTOR

Concurrent additional Contractor's may be working on site and in same units. Other Contractors will be working in family housing units painting or doing various work. The Contracting Officer will make every effort to avoid both operations occurring concurrently in any one unit; however, should either operation interfere with the other, the Contracting Officer shall be notified immediately.

1.4 UNATTENDED CHILDREN

Unattended children including toddlers, will be on-site constantly; therefore, extreme caution shall be used while executing the work to avoid injury to children, as well as everyone else.

1.5 LAWN PRESERVATION

Lawm preservation shall be a major goal of the Contractor. Should any damage occur, the damaged lawn area shall be sodded within 24 hours.

1.6 WORK IN FAMILY HOUSING

Work in family housing shall not begin until 8:00 a.m.

1.6.1 Overhead Wires

Each building is served by several electrical lines, often connected to firewall just above the roof, and also by several tele phone drop wires and cable television lines.

1.6.2 Fences Existing On Site

Fences exist on the site, frequently continuing up to the buildings. Removal of the fenses which prevent feasible shingle removal and reinstallation will be accomplished within the same day by the Contractor, but only when the Government is convinced no feasible means of shingle removal remains. Ten days notice will be required on each case for the Government to decide and five days to remove said intruding fences.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE EP-1110-1-8	(1995) Construction Equipment Ownership and Operating Expense Schedule

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00,"Submittal Procedures."

SD-01 Preconstruction Submittals

Schedule of prices

1.3 SCHEDULE OF PRICES

1.3.1 Data Required

Within 15 calendar days of notice of award, prepare and deliver to Contracting Officer a schedule of prices (construction contract) on the forms furnished by the Government. Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices therefor. Schedule of prices shall be separated by individual building numbers with subtotals for each building.

1.3.2 Schedule Instructions

Payments will not be made until the schedule of prices has been submitted to and approved by the Contracting Officer. Identify the cost for site work, and include incidental work to the 5 foot line. Identify costs for the building(s), and include work out to the 5 foot line. Workout to the 5 foot line shall include construction encompassed within a theoretical line 5 feet from the face of exterior walls and shall include attendant construction, such as cooling towers, placed beyond the 5 foot line.

1.3.3 Schedule Requirements for HVAC TAB

The field work Section 23 05 92, "HVAC Testing/Adjusting/Balancing" shall be broken down in the Schedule of Prices and in the Construction Progress Documentation by separate line items which reflect measurable deliverables. Specific payment percentages for each line item shall be determined on a case by case basis for each contract. The line items shall be as follows:

a. Approval of Design Review Report: The TABS Agency is required to conduct a review of the project plans and specifications to identify any feature, or the lack thereof, that would preclude successful testing and balancing of the project HVAC systems. The resulting findings shall be submitted to the Government to allow correction of the design. The progress payment shall be issued after review and approval of the report.

b. Approval of the pre-field engineering report: The TABS Agency submits a report which outlines the scope of field work. The report shall contain details of what systems will be tested, procedures to be used, sample report forms for reporting test results and a quality control checklist of work items that must be completed before TABS field work commences.

c. Season I field work: Incremental payments are issued as the TABS field work progresses. The TABS Agency mobilizes to the project site and executes the field work as outlined in the pre-field engineering report. The HVAC water and air systems are balanced and operational data shall be collected for one seasonal condition (either summer or winter depending on project timing).

d. Approval of Season I report: On completion of the Season I field work, the data is compiled into a report and submitted to the Government. The report is reviewed, and approved, after ensuring compliance with the pre-field engineering report scope of work.

e. Completion of Season I field QA check: Contract QC and Government representatives meet the TABS Agency at the jobsite to retest portions of the systems reported in the Season I report. The purpose of these tests are to validate the accuracy and completeness of the previously submitted Season I report.

f. Approval of Season II report: The TABS Agency completes all Season II field work, which is normally comprised mainly of taking heat transfer temperature readings, in the season opposite of that under which Season I performance data was compiled. This data shall be compiled into a report and submitted to the Government. On completion of submittal review to ensure compliance with the pre-field engineering report scope, progress payment is issued. Progress payment is less than that issued for the Season I report since most of the water and air balancing work effort is completed under Season I.

1.4 CONTRACT MODIFICATIONS

In conjunction with the Contract Clause "DFARS 252.236-7000, Modification Proposals-Price Breakdown," and where actual ownership and operating costs of construction equipment cannot be determined from Contractor accounting records, equipment use rates shall be based upon the applicable provisions of the COE EP-1110-1-8.

1.5 CONTRACTOR'S PAYMENT REQUEST

1.5.1 Proper Payment Request

A proper request for payment/invoice shall comply with all requirements specified in this Section and the contract payment clauses. If any invoice

does not comply with these requirements, it shall be returned with a statement of the reasons why it was not a proper invoice. A proper payment request/invoice includes the following information, completed forms, and number of copies indicated. Upon request, the Contracting Officer will furnish copies of Government forms.

a. Contractor's Invoice on NAVFAC Form 7300/30, which shall show the basis for arriving at the amount of the invoice. Submit one original and two copies.

b. Contractor's Monthly Estimate for Voucher (LANTNAVFACENGCOM Form 4-4330/110. Submit original and two copies.

c. Payment Certification. Furnish as specified in "FAR Clause 52.232-5 (c) Payments under Fixed-Price Construction Contracts." Submit one original.

d. QC Invoice Certification. Furnish as specified in Section 01 45 10, "Quality Control." Submit one original.

1.5.1.1 Progress Payments

In addition to the requirements stated in Paragraph 1.5.1, "Proper Payment Request" above, the Contractor's request for progress payments shall include the following:

a. Updated Progress Schedule: Furnish an updated progress schedule as specified in contract clause FAR 52.236-15 "Schedules for Construction Contracts" and Section 01 32 16, "Construction Progress Documentation." Submit one copy.

1.5.1.2 Final Payments

The request for final payment is submitted after completion and acceptance of all work and all other requirements of the contract. Before submitting the final invoice the Contractor shall meet with the appropriate Government representatives to determine the final invoice amount, including the assessment of liquidated damages, if any, and to make sure the final release is complete and accurate. In addition to the requirements in Paragraph 1.5.1, "Proper Payment Request" above, the Contractor's request for final payment shall include the following:

a. A final release executed on the standard form provided by the Contracting Officer. Submit two originals with final payment request.

b. NC Tax certified statement and report for the prime and each subcontractor (FAR 52.229-7). Submit two copies.

c. As-built drawings (if applicable).

d. Warranties (if applicable).

e. O&M manuals (if applicable).

f. Final payrolls (FAR 52.222-6).

g. A release for an assignment of claims (if applicable). Submit three originals.

1.5.2 Procedures for Submitting Payment Request

a. The Contractor may submit only one invoice for payment each month as the work progresses.

b. The invoice shall be delivered to the ROICC Office, Administrative Branch, between five calendar days before and five calendar days after the contract award date. Invoices received outside this schedule shall be returned to the Contractor unprocessed. The Contractor will have to wait until the following month to submit their next invoice.

c. Invoices shall be delivered during normal work hours from 7:30 AM up to 4:00 PM (EST), Monday through Friday, excluding holidays.

1.6 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of a proper payment request/invoice by the Contractor.

1.6.1 Obligation of Government Payments

The obligation of the Government to make payments required under the provisions of this contract will, at the discretion of the Contracting Officer, be subject to the following:

a. Reasonable retention and/or deductions due to defects in material or workmanship; potential liquidated damages; and/or failure to comply with any other requirements of the contract.

b. Claims which the Government may have against the Contractor under or in connection with this contract; and

c. Unless otherwise adjusted, repayment to the Government upon demand for overpayments made to the Contractor.

d. Failure to provide up to date record drawings not current as stated in Contract Clause "FAC 5252.236-9310, Record Drawings"; NC State tax certified statement and report in accordance with FAR 52.229-2; labor payrolls in accordance with FAR 52.222-6; as-built drawings in accordance with Section 01 45 10, "Quality Control"; warranties and O&M manuals; and any other requirements in the contract.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

02/11

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with the Section 01 33 00, "Submittal Procedures."

SD-01 Preconstruction Submittals

List of contact personnel

1.2 MINIMUM INSURANCE REQUIREMENTS

Procure and maintain during the entire period of performance under this contract the following minimum insurance coverage:

a. Comprehensive general liability: $500,000 per occurrence

b. Automobile liability: $200,000 per person, $500,000 per occurrence, $20,000 per occurrence for property damage

c. Workmen's compensation as required by Federal and State workers' compensation and occupational disease laws,

d. Employer's liability coverage of $100,000, except in States where workers compensation may not be written by private carriers,

e. Others as required by State law.

1.3 ELECTRONIC MAIL (EMAIL)

a. The Contractor is required to establish and maintain electronic mail (email) capability along with the capability to open various electronic attachments in Microsoft, Adobe Acrobat, and other similar formats.

b. Within 10 days after contract award; the Contractor shall provide the Contracting Officer a single (only one) email address for the ROICC office to send communications related to this contract correspondence. The ROICC office may also use email to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes, terrorist threats, etc.

c. Multiple email addresses are not authorized.

d. It is the Contractor's responsibility to make timely distribution of all ROICC email within its own organization, including field office(s).

e. The Contractor shall promptly notify the Contracting Officer, in writing, of any changes to their email address.

1.4 CONTRACTOR PERSONNEL REQUIREMENTS

1.4.1 Subcontractors and Personnel

Furnish a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.4.2 Identification Badges

Identification badges will be furnished without charge. Application for and use of badges will be as directed below. Immediately report instances of lost or stolen badges to the Contracting Officer. Employees are required to resubmit a complete 50 state criminal records check in order to renew their contractor badge.

1.4.3 Business Access Security Requirements

1.4.3.1 Business Access Definition

Contractor/subcontractor employees requiring installation access to MCB, Camp Lejeune or MCAS New River, N.C. must obtain a Business Access Identification Badge for that particular installation. Regularly scheduled delivery personnel, to include FEDEX, UPS, Pick-up and deliveries, should, also, follow the Business Access guidelines described below. Personnel requiring Business Access Identification Badges shall submit all documentation listed below. Badges are not required if the contracted position requires the employee to obtain a Common Access Card (CAC) which will be identified separately within the Government contract.

1.4.3.2 Installation Security Access Requirements

Contractor shall accomplish the security requirements below within 10 days after award or prior to performance under the contract.

1.4.3.3 Business Access Identification Badge Requirement

In order to obtain a Business Access Identification Badge for access to MCB, Camp Lejeune, and satellite activities, or MCAS New River, NC, all personnel providing services under this contract shall be required to present the documentation below to the following offices, as applicable:

MCB, Camp Lejeune, NC and its satellite activities. Report as follows:

1. Identification Card Center, 60 Molly Pitcher Road for badge (910-450-8444).

MCAS New River, NC. Report as follows:

1. Pass and Identification Office, Bldg AS-187 for badge (910-449-7695) and vehicle pass (910-449-5513).

1.4.3.4 Proof of Employee Citizenship or Legal Alien Status

Employers may participate in the E-verify program (1-888-464-4218, www.DHS.gov/e-verify) allowing U.S. employers to verify name, DOB, and SSN along with immigration information for non-citizens, against federal

databases in order to verify the employment eligibility of both citizens and non-citizen new hires.

1.4.3.5 Proof of Criminal Records Check

Commercial and contract employees must provide proof a complete 50 state criminal records check on an annual basis. The record check may be obtained from any of the following Internet investigative services: Kroll (former Infolink Screening Services) at www.kroll.com, Castle Branch at www.castlebranch.com, or any other investigative services company that provides records checks for all 50 states. These services also validate social security card numbers. All criminal history checks must be completed no more than 30 days prior to start date of contract. (Note: These Internet screening services are listed as possible sources for obtaining a criminal background check. The United States government and the United States Marine Corps do not endorse nor are they affiliated with any of these services).

1.4.3.6 Letter Provided By Contracting Officer Indicating Contract

Letter provided by Contracting Officer indicating contract, contract period and prime contractor. Proof of employment on a valid Government contract (e.g., a letter on company letterhead from the prime contractor including contract number and term).

1.4.3.7 Photo ID

Valid state or federal issued picture identification card. Acceptable documents include state drivers license, DMV issued photo identification, or alien registration card.

1.4.3.8 National Crime Investigation Center (NCIC) Check

Provost Marshals are authorized to conduct a national crime information center (NCIC) check of all persons entering the installation, if/where applicable, the NCIC check may include drivers's license query, wants and warrants, and criminal history.

1.4.4 Denial of Access

Installation access shall be denied if it is determined that an employee:

a. Is on the National Terrorist Watch List

b. Is illegally present in the United States.

c. Is subject to an outstanding warrant.

d. Has knowingly submitted an employment questionnaire with false or fraudulent information.

e. Has been issued a debarment order and is currently banned from military installations.

f. Is a Registered Sexual Offender.

g. Has been convicted of a felony or a drug crime within the past five years.

h. Individuals who have received a DUI/DWI in the last year may be allowed access to the installation, but will not be permitted to drive on the installation.

i. Any reason the Installation Commander deems reasonable for the good order and discipline.

1.4.5 Appeal Process

All appeals should be directed to the Base Inspector's Office for any individual that has been denied access to the Base.

1.4.6 Display of Badges

Contractors/subcontractors shall prominently display their badges on their person at all times. Upon completion/termination of this contract or an individual's employment, the Contractor shall collect and turn in to the Pass & ID Office all badges. If the Contactor fails to obtain the employee's badge, the Pass & ID Office will be notified within 24 hours. Immediately report instances of lost or stolen badges to the Contracting Officer.

1.4.7 Contractor and Subcontractor Vehicle Requirements

Each vehicle to be used in contract performance shall show the Contractor's or subcontractor's name so that it is clearly visible and shall always display a valid state license plate and safety inspection sticker. To obtain a vehicle decal, which will be valid for one year or contract period, whichever is shorter, Contractor or subcontractor vehicle operators shall provide to the Vehicle Registration Office, 60 Molly Pitcher Road (910-451-1158) or to MCAS, Building AS-187 (910-449-5513) for vehicle decal:

a. An installation sponsor request forwarded to provost Marshall office

b. A valid form of Federal or state government I.D.

c. If driving a motor vehicle, a valid driver's license, vehicle registration and proof of insurance

Upon completion/termination of this contract or an individual's employment, the Contractor shall collect and turn in to Vehicle Registration all Government vehicle decals. If any are not collected, the Contractor shall notify the Vehicle Registration Office within 24 hours.

1.4.8 Security Checks

Contractor personnel and vehicles shall only be present in locations relevant to contract performance. All Contractor personnel entering the base shall conform to all Government regulations and are subject to such checks as may be deemed necessary to ensure that violations do not occur. Employees shall not be permitted on base when such a check reveals that their presence would be detrimental to the security of the base. Subject to security regulations, the Government will allow access to an area for servicing equipment and/or performing required services. Upon request, the Contractor shall submit to the Contracting Officer questionnaires and other forms as may be required for security purposes.

1.4.9 Subcontractor Special Requirements

1.4.9.1 Asbestos Containing Material

All contract requirements of Section 02 82 18, "Removal and Disposal of Asbestos Materials For Dependent Schools," Section 02 82 16, "Removal and Disposal of Asbestos Materials," and Section 02 82 17, "Removal and Disposal of Non-Regulated Asbestos Containing Materials" assigned to the Private Qualified Person (PQP) shall be accomplished directly by a first tier subcontractor.

1.4.9.2 Space Temperature Control, HVAC TAB, and Apparatus Inspection

All contract requirements of Section 23 09 53.00 20, Space Temperature Control Systems," Section 23 09 54, Direct Digital Control System," Section 23 08 00.00 20, "HVAC Testing/Adjusting/Balancing," and Section 26 08 00, "Apparatus Inspection and Testing" shall be accomplished directly by a first tier subcontractor. No work required by Section 23 09 53.00 20 23 09 54, 23 08 00.00 20, or 26 08 00 shall be accomplished by a second tier subcontractor.

1.4.9.3 Telecommunication and High Voltage Work

When telecommunications and high voltage work is required, all work associated with telecommunications and high voltage shall be accomplished by a first tier subcontractor. The contractor must possess a valid North Carolina Public Utility - Electrical, contractor's license and be insured to do such work in the State of North Carolina.

1.5 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site during working hours. In addition, if a Quality Control (CQ) representative is required on the contract, then that individual shall also have fluent English communication skills.

NOTE: If training and experience requirements of Section 01 45 10, "Quality Control" and 01 35 29, "Safety and Occupational Health Requirements" have been met the supervisor may also serve as QC Manager and Site Safety and Health Officer (SSHO).

1.6 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the Contracting Officer to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule of prices, shop drawings, and other submittals, scheduling programming, and prosecution of the work. Major subcontractors who will engage in the work shall also attend.

1.7 PARTNERING

Contract Partnering Level C
This level of partnering discusses partnering concepts and benefits and should become a part of the pre-performance conference. The senior Government and Contractor stakeholders present will jointly host the partnering sessions. The partners will determine the frequency of the follow-on sessions. The partnering sessions should be held at locations

agreed to by the partners. Partnering sessions should be held at or near the location of the activity Contracting Office. The participants shall bear their own costs for meals, lodging, and transportation associated with partnering.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 31 50

TRANSFER AND ACCEPTANCE OF MILITARY REAL PROPERTY

01/07

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

Interim DD-1354, Transfer & Acceptance of Military Real Property

1.2 Interim DD-1354, Transfer & Acceptance of Military Real Property

Submit Interim DD-1354 thirty (30) days prior to beneficial occupancy date (draft copy attached).

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01 32 16

CONSTRUCTION PROGRESS DOCUMENTATION

06/11

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-01 Preconstruction Submittals

Construction schedule

Equipment delivery schedule

1.2 CONSTRUCTION SCHEDULE

Within 21 days after receipt of the Notice of Award, prepare and submit to the Contracting Officer for approval a Critical Path Method (CPM), Network Schedule in accordance with the terms in Contract Clause "FAR 52.236-15, Schedules for Construction Contracts," except as modified in this contract. Primavera P6 will be utilized to produce and update all progress schedules.

1.2.1 HVAC TAB Milestones

Requirements for the milestones related to HVAC TAB work, Section 23 08 00.00 20, "HVAC Testing/Adjusting/Balancing," are specified in Section 01 20 00, "Price and Payment Procedures."

1.3 EQUIPMENT DELIVERY SCHEDULE

1.3.1 Initial Schedule

Within 30 calendar days after approval of the proposed construction schedule, submit for Contracting Officer approval a schedule showing procurement plans for materials, plant, and equipment. Submit in the format and content as prescribed by the Contracting Officer, and include as a minimum the following information:

a. Description.

b. Date of the purchase order.

c. Promised shipping date.

d. Name of the manufacturer or supplier.

e. Date delivery is expected.

f. Date the material or equipment is required, according to the current construction schedule.

1.4 NETWORK ANALYSIS SYSTEM (NAS)

The Contractor shall use the critical path method (CPM) to schedule and control construction activities. The Network shall have a minimum of _____ activities and a maximum of _____ activities. The schedule shall identify as a minimum:

a. Construction time for all major systems and components;

b. Manpower requirements for each activity;

c. Major submittals and submittal processing time; and

d. Major equipment lead time.

1.4.1 CPM Submittals and Procedures

Submit all network analysis and updates in hard copy. Also submit CPM network schedule on CD. The network analysis system shall be submitted using Primavera P6 software and be capable of running on an IBM compatible computer (IBM is a registered trademark of International Business Machines), operating with "Microsoft Windows 95". The network analysis system shall be kept current, with changes made to reflect the actual progress and status of the construction.

1.5 UPDATED SCHEDULES

Update the construction schedule and equipment delivery schedule at monthly intervals or when schedule has been revised. Reflect any changes occurring since the last update. Submit copies of the purchase orders and confirmation of the delivery dates as directed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES

12/10

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Government-Furnished Information

Submittal register will be delivered to the contractor in hard copy format. Register will have the following fields completed, to the extent that will be required by the Government during subsequent usage.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-04 Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

Column (f): Indicate approving authority for each submittal. The Contracting Officer is approving authority for all submittals.

1.2 DEFINITIONS

1.2.1 Submittal

Shop drawings, product data, samples, and administrative submittals presented for review and approval. Contract Clauses "FAR 52.236-5, Material and Workmanship," paragraph (b) and "FAR 52.236-21, Specifications and Drawings for Construction," paragraphs (d), (e), and (f) apply to all "submittals."

1.2.2 Types of Submittals

All submittals are classified as indicated in paragraph "Submittal Descriptions (SD)". Submittals also are grouped as follows:

a. Shop drawings: As used in this section, drawings, schedules, diagrams, and other data prepared specifically for this contract, by contractor or through contractor by way of subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate portion of work.

b. Product data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate portion of work, but not prepared exclusively for this contract.

c. Samples: Physical examples of products, materials, equipment,

assemblies, or workmanship that are physically identical to portion of work, illustrating portion of work or establishing standards for evaluating appearance of finished work or both.

d. Administrative submittals: Data presented for reviews and approval to ensure that administrative requirements of project are adequately met but not to ensure directly that work is in accordance with design concept and in compliance with contract documents.

1.2.3 Submittal Descriptions (SD)

SD-01 Preconstruction Submittals

Certificates of insurance
Surety bonds
List of proposed subcontractors
List of proposed products
Construction Progress Schedule
Submittal schedule
Schedule of values
Health and safety plan
Work plan
Quality control plan
Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the contractor for integrating the product or system into the project.

Drawings prepared by or for the contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the contractor on an actual portion of the work or prototype prepared for the

project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

Factory test reports.

SD-10 Operation and Maintenance Data

Data intended to be incorporated in operations and maintenance manuals.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

As-built drawings

Special warranties

Posted operating instructions

Training plan

1.2.4 Approving Authority

Person authorized to approve submittal.

1.2.5 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce construction and materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 SUBMITTALS

Submit the following in accordance with the requirements of this section.

SD-11 Closeout Submittals

Submittal register

Complete Submittal Package 1 CD

1.4 USE OF SUBMITTAL REGISTER

Prepare and maintain submittal register, as the work progresses. Use the hard copy submittal register furnished by the Government or other approved format. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by government; retain data which is output in columns (a), (g), (h), and (i) as approved.

1.4.1 Submittal Register

Submit submittal register as a hard copy. Submit with quality control plan and project schedule required by Section 01 45 10 or 01 45 00, "Quality Control" and Section 01 32 17, "Network Analysis Schedules" or Section 01 32 16, "Construction Progress Documentation." Do not change data in columns (c), (d), (e), and (f) as delivered by the government. Verify that all submittals required for project are listed and add missing submittals. Complete the following on the register:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date contractor needs approval of submittal.

Column (i) Contractor Material: Date that contractor needs material delivered to contractor control.

1.4.2 Contractor Use of Submittal Register

Update the following fields in the government-furnished submittal register.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record contractor's

review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.4.3 Approving Authority Use of Submittal Register

Update the following fields in the government-furnished submittal register.

Column (b).

Column (l) List date of submittal receipt.

Column (m) through (p).

Column (q) List date returned to contractor.

1.4.4 Contractor Action Code and Action Code

Entries used will be as follows (others may be prescribed by Transmittal Form):

NR - Not Received

AN - Approved as noted

A - Approved

RR - Disapproved, Revise, and Resubmit

1.4.5 Copies Delivered to the Government

Deliver one copy of submitted register updated by contractor to government with each invoice request.

1.5 PROCEDURES FOR SUBMITTALS

1.5.1 Reviewing, Certifying, Approving Authority

QC organization shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. The Contracting Officer is the approving authority for all submittals.

1.5.2 Constraints

a. Submittals listed or specified in this contract shall conform to provisions of this section, unless explicitly stated otherwise.

b. Submittals shall be complete for each definable feature of work; components of definable feature interrelated as a system shall be submitted at same time.

c. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

d. Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

1.5.3 Scheduling

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.

b. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 15 working days for submittals for QC manager approval and 20 working days for submittals for contracting officer approval. Period of review for submittals with contracting officer approval begins when Government receives submittal from QC organization. Period of review for each resubmittal is the same as for initial submittal.

c. For submittals requiring review by fire protection engineer, allow review period, beginning when government receives submittal from QC organization, of 45 working days for return of submittal to the contractor. Period of review for each resubmittal is the same as for initial submittal.

1.5.4 Variations

Variations from contract requirements require Government approval pursuant to contract Clause entitled "FAR 52.236-21, Specifications and Drawings for Construction" and will be considered where advantageous to government.

1.5.4.1 Considering Variations

Discussion with contracting officer prior to submission, will help ensure functional and quality requirements are met and minimize rejections and resubmittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

1.5.4.2 Proposing Variations

When proposing variation, deliver written request to the contracting officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to government. If lower cost is a benefit, also include an estimate of the cost saving. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.5.4.3 Warranting That Variation Are Compatible

When delivering a variation for approval, contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.5.4.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.5.5 Contractor's Responsibilities

a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and contract documents.

b. Transmit submittals to QC organization in accordance with schedule on approved Submittal Register, and to prevent delays in the work, delays to government, or delays to separate contractors.

c. Advise contracting officer of variation, as required by paragraph entitled "Variations."

d. Correct and resubmit submittal as directed by approving authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the contractor shall provide copy of that previously submitted transmittal including all reviewer comments for use by approving authority. Direct specific attention in writing or on resubmitted submittal, to revisions not requested by approving authority on previous submissions.

e. Furnish additional copies of submittal when requested by contracting officer, to a limit of 20 copies per submittal.

f. Complete work which must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.

g. Ensure no work has begun until submittals for that work have been returned as "approved," or "approved as noted", except to the extent that a portion of work must be accomplished as basis of submittal.

1.5.6 QC Organization Responsibilities

a. Note date on which submittal was received from contractor on each submittal.

b. Review each submittal; and check and coordinate each submittal with requirements of work and contract documents.

c. Review submittals for conformance with project design concepts and compliance with contract documents.

d. Act on submittals, determining appropriate action based on QC organization's review of submittal.

(1) When QC manager is approving authority, take appropriate action on submittal from the possible actions defined in paragraph entitled, "Actions Possible."

(2) When contracting officer is approving authority or when variation has been proposed, forward submittal to Government with certifying statement or return submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of submittal determines appropriate action.

e. Ensure that material is clearly legible.

f. Stamp each sheet of each submittal with QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When approving authority is contracting officer, QC organization will certify submittals forwarded to contracting officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract Number N40085- -B- , is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Certified by QC manager _____, Date _____"
(Signature)

g. Sign certifying statement or approval statement. The person signing certifying statements shall be QC organization member designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable.

h. Update submittal register as submittal actions occur and maintain the submittal register at project site until final acceptance of all work by contracting officer.

i. Retain a copy of approved submittals at project site, including contractor's copy of approved samples.

1.5.7 Government's Responsibilities

When approving authority is contracting Officer, the Government will:

a. Note date on which submittal was received from QC manager, on each submittal for which the contracting officer is approving authority.

b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph entitled "Actions Possible" and with markings appropriate for action indicated.

1.5.8 Actions Possible

Submittals will be returned with one of the following notations:

a. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required , does not have evidence of being reviewed and approved by contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by contractor or for being

incomplete, with appropriate action, coordination, or change.

b. Submittals marked "approved" "approved as submitted" authorize contractor to proceed with work covered.

c. Submittals marked "approved as noted" authorize contractor to proceed with work as noted provided contractor takes no exception to the notations.

d. Submittals marked "revise and resubmit" or "disapproved" indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until resubmittal is approved.

1.6 FORMAT OF SUBMITTALS

1.6.1 Complete Submittal Package

Contractor shall make electronic copies of all submittals, including the transmittal sheet, and provide a CD/DVD containing all submittals for project close out.

The CD/DVD shall be marked "Complete Submittal Package - Contract #_____."

1.6.2 Transmittal Form

Transmit each submittal, except sample installations and sample panels, to office of approving authority. Transmit submittals with transmittal form prescribed by contracting officer and standard for project. The transmittal form shall identify contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

1.6.3 Identifying Submittals

Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Section number of the specification section by which submittal is required.

d. Submittal description (SD) number of each component of submittal.

e. When a resubmission, alphabetic suffix on submittal description, for example, SD-10A, to indicate resubmission.

f. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second tier contractor associated with submittal.

g. Product identification and location in project.

1.6.4 Format for Product Data

a. Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

b. Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

c. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project.

1.6.5 Format for Shop Drawings

a. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 by 42 inches.

b. Present 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.

c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled "Identifying Submittals."

d. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Shop drawing dimensions shall be the same unit of measure as indicated on the contract drawings. Identify materials and products for work shown.

1.6.6 Format of Samples

a. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:

(1) Sample of Equipment or Device: Full size.

(2) Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.

(3) Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

(4) Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

(5) Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

(6) Color Selection Samples: 2 by 4 inches.

(7) Sample Panel: 4 by 4 feet.

(8) Sample Installation: 100 square feet.

b. Samples Showing Range of Variation: Where variations are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range.

c. Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples shall be in undamaged condition at time of use.

d. Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean up of project.

e. When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.6.7 Format of Administrative Submittals

a. When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply contractor's approval stamp to document, but to a separate sheet accompanying document.

b. Operation and Maintenance Manual Data: Submit in accordance with Section 01 78 23, "Operation and Maintenance Data." Include components required in that section and the various technical sections.

1.7 QUANTITY OF SUBMITTALS

1.7.1 Number of Copies of Product Data

a. Submit five copies of submittals of product data requiring review and approval only by the Contracting Officer. Submit three copies of submittals of product data for operation and maintenance manuals.

1.7.2 Number of Copies of Shop Drawings

Submit shop drawings in compliance with quantity requirements specified for product data.

1.7.3 Number of Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to contractor.

b. Submit one sample panel. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.7.4 Number of Copies of Administrative Submittals

a. Unless otherwise specified, submit administrative submittals compliance with quantity requirements specified for product data.

b. Submit administrative submittals required under "SD-19 Operation and Maintenance Manuals" to conform to Section 01 78 23, "Operation and Maintenance Data."

1.8 FORWARDING SUBMITTALS

1.8.1 Samples and Submittalsr

Except as otherwise noted, submit samples and submittals to:

ROICC/OICC
Jacksonville, North Carolina Area
1005 Michael Road
Camp Lejeune, NC 28542-2521

- OR -

Architect-Engineer Firm
Full Address

1.8.1.1 Administrative Submittals

Submit administrative submittals for asbestos/lead removal and environmental protection plan to the Resident Officer in Charge of Construction (ROICC/OICC).

1.8.1.2 Fire Protection and Fire Alarm System Submittals

Submit fire protection and fire alarm system submittals to NAVFAC MidLant, NAVFAC MIDLANT Fire Protection Engineer, 9742 Maryland Ave., Building Z-140, Room 219, Norfolk, VA 23511 or ROICC/OICC.

1.8.1.3 TAB Submittals

Submit to ROICC/OICC for all projects.

1.8.2 Shop Drawings, Product Data, and O&M Data

As soon as practicable after award of the contract, and before procurement or fabrication, submit shop drawings, product data and O&M Data required in the technical sections of this specification.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

MULTIPLE AWARD CONSTRUCTION CONTRACT SPECIFICATION

CONTRACTOR

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		01 20 00	SD-01 Preconstruction Submittals																
			Schedule of prices	1.3															
		01 30 00	SD-01 Preconstruction Submittals																
			List of contact personnel	1.4.1															
		01 31 50	SD-11 Closeout Submittals																
			Interim DD-1354, Transfer &	1.2															
			Acceptance of Military Real																
			Property																
		01 32 16	SD-01 Preconstruction Submittals																
			Construction schedule	1.2															
			Equipment delivery schedule	1.3															
		01 33 00	SD-11 Closeout Submittals																
			Submittal register	1.4.1															
			Complete Submittal Package	1.6.1															
		01 35 29	SD-01 Preconstruction Submittals																
			Accident Prevention Plan (APP)	1.9															
			Activity Hazard Analysis (AHA)	1.10															
			Crane Critical Lift Plan	1.9.1															
			Crane Work Plan	1.9.1															
			Crane Operators	1.7.1.6															
			SD-06 Test Reports																
			Reports	1.14															
			Accident Reports	1.14.1															
			Monthly Exposure Reports	1.14.3															
			Regulatory Citations and	1.14.4															
			Violations																

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		01 35 29	Crane Reports	1.14.5														
			SD-07 Certificates															
			Confined Space Entry Permit	1.11														
			Certificate of Compliance	1.14.6														
			Third Party Certification of	1.14.7														
			Barge-Mounted Mobile Cranes															
		01 45 10	SD-11 Closeout Submittals															
			QC PLAN	1.6														
		01 50 00	SD-01 Preconstruction Submittals															
			Traffic control plan	1.6.1.1														
			SD-03 Product Data															
			Backflow preventers	2.1														
			SD-06 Test Reports															
			Backflow Preventer Tests	3.1														
			SD-07 Certificates															
			Backflow Tester Certifications	1.3														
			Backflow Preventers Certificate	1.3.1														
		01 57 19	SD-01 Preconstruction Submittals															
			Environmental protection plan	1.6.1														
			Preconstruction survey	1.6.4														
			MSDS for Class I ODS waivered	1.7.2														
			product															
			Permit for storm water discharge	1.7														
			Notice of Intent	1.7														
			Notice of Intent	1.7.1														
			Notice of Termination	1.7														

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		01 57 19	Pollution Prevention Plan	1.7														
			SD-06 Test Reports															
			Abrasive blasting	3.8.1														
			SD-11 Closeout Submittals															
			Solid waste disposal permit	1.4.1														
			Disposal permit for hazardous	1.4.2														
			waste															
			Environmental training	1.2														
			documentation															
			Permit to transport hazardous	1.4.3														
			waste															
			Hazardous waste certification	1.4.4														
			Erosion and sediment control	1.4.5														
			inspection reports															
			Environmental Plan Review	1.6.3														
			Annual Report of Products	2.1														
			Containing Recovered Materials															
		01 60 00	SD-07 Certificates															
			Certificate of North Carolina	1.1.1														
			Licensed Applicator															
			SD-11 Closeout Submittals															
			Field Pesticide/Herbicide	1.1.2														
			Management Record Form															
		01 78 00	SD-10 Operation and Maintenance															
			Data															
			Equipment/product warranty list	1.4.1														

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		01 78 00	SD-11 Closeout Submittals															
			As-built drawings	1.2.1														
			GIS Deliverables	1.3														
			Record of materials	1.3.3														
			Maximo requirements	1.3.4														
			Complete Submittal Package	1.5														
			Equipment/product warranty tag	1.4.2														
		02 41 00	SD-01 Preconstruction Submittals															
			Existing Conditions	1.6.2														
			SD-07 Certificates															
			Demolition Plan	1.10														
			Notifications	1.4.1														
			Notification of Demolition and															
			Renovation forms															
			SD-11 Closeout Submittals															
			Receipts	1.4.2														
		02 81 00	SD-03 Product Data															
			On-site Hazardous Waste	3.1														
			Management															
			Notices of Non-Compliance and	3.2														
			Notices of Violation															
			SD-06 Test Reports															
			Recordkeeping	3.7														
			Spill Response	3.8														
			Exception Reports	3.7														
			Packaging Notifications	2.1.1														

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		02 81 00	SD-07 Certificates																
			Certification	1.4.3															
			Security Plan	3.2.4															
			Transportation and Disposal	1.4.1															
			Coordinator																
			Training	1.4.2															
			EPA Off-Site Policy	3.2.2															
			Certificates of Disposal	3.2.5															
			Shipping Documents and	3.2.3															
			Packagings Certification																
			Waste Minimization	3.6															
		02 82 16	SD-06 Test Reports																
			Air sampling results	1.5.2															
			Pressure differential recordings	1.5.3															
			for local exhaust system																
			Clearance sampling	3.3.3.2															
			SD-07 Certificates																
			Asbestos hazard abatement plan	1.5.1															
			SD-11 Closeout Submittals																
			Asbestos Waste Shipment	1.5.4															
			Record (DEHNR 3787)																
			Daily log	1.5.5															
			North Carolina permit	1.5.6															
			Modifications to the North	1.5.7															
			Carolina permit																

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		02 82 16	Asbestos Inspection Reporting	1.5.8														
			Form															
		02 82 17	SD-06 Test Reports															
			DEHRN 3787	3.1														
		02 82 18	SD-03 Product Data															
			Local exhaust equipment	3.2.4														
			Vacuums	3.2.5														
			Respirators	3.2.1.1														
			Pressure differential automatic	3.2.4														
			recording instrument															
			Amended water	1.3.3														
			Glovebag	3.3.4.2														
			Material Safety Data Sheets	1.4.8														
			(MSDS) for all materials															
			SD-06 Test Reports															
			Air sampling results	1.5.6														
			Pressure differential recordings	1.5.7														
			for local exhaust system															
			Clearance sampling	3.3.6.3														
			Clearance sampling	3.3.6.4														
			SD-07 Certificates															
			Asbestos hazard abatement plan	1.5.1														
			Testing laboratory	1.5.2														
			Supervising Air Monitor (SAM	1.5.3														
			Employee Accreditation	1.5.4														
			Medical certification	1.5.5														

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		02 82 18	Vacuums	3.2.5														
			Water filtration equipment	3.2.2.3														
			Ventilation systems	3.2.5														
			equipment required to contain	3.2														
			airborne asbestos fibers															
			encapsulants	2.1														
			SD-11 Closeout Submittals															
			Notifications	1.5.8														
			Rental equipment	1.5.9														
			Respirator program records	1.5.10														
			Asbestos Waste Shipment	1.5.11														
			Record (DEHNR 3787)															
			Daily log	1.5.12														
			Preliminary North Carolina permit	1.5.13														
			application															
			North Carolina permit	1.5.14														
			Modifications to the North	1.5.15														
			Carolina permit															
			Asbestos Inspection Reporting	1.5.16														
			Form															
			Response action completion	1.5.17														
			report.															
			Asbestos Free Certification	1.5.18														
		02 82 33.12	SD-03 Product Data															
			Vacuum filters	1.5.4														
			Respirators	1.5.1														

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		02 82 33.12	SD-06 Test Reports															
			Monitoring Results	1.4.4														
			SD-07 Certificates															
			Qualifications of CIH	1.4.1														
			Testing laboratory	1.4.2														
			Rental equipment notification	1.5.3														
			Preparation of Surfaces Coated	1.4.3														
			with Lead-Contaminated Paint															
			Work Plan															
			Respiratory protection program	1.3.4														
			Hazard communication program	1.3.5														
			disposal facility	3.4														
			Hazardous waste management	1.3.6														
			plan															
			Vacuum filters	1.5.4														
			SD-11 Closeout Submittals															
			manifest	3.4														
			medical examinations	1.3.1														
			training certification	1.3.3.1														
		02 82 33.13	SD-03 Product Data															
			Vacuum filters	1.6.4														
			Respirators	1.6.1														
			SD-06 Test Reports															
			Monitoring Results	1.4.4														
			SD-07 Certificates															
			Qualifications of CIH	1.4.1														

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		02 82 33.13	Testing laboratory	1.4.2														
			Materials coated with	1.4.3														
			lead-containing paint removal work															
			plan															
			Rental equipment notification	1.6.3														
			work plan	1.3.8														
			Respiratory protection program	1.3.4														
			Hazard communication program	1.3.5														
			disposal	3.4.4														
			Hazardous waste management	1.3.6														
			plan															
			Vacuum filters	1.6.4														
			SD-11 Closeout Submittals															
			disposal	3.4.4														
			medical examinations	1.3.1														
			training certification	1.3.3.1														
		03 01 30.71	SD-05 Design Data															
			Job mix formula	1.4.1.1														
			SD-06 Test Reports															
			aggregate	2.1.2														
			Epoxy resin binder	2.1.1.1														
			Epoxy grout	2.1.1.2														
			SD-07 Certificates															
			Epoxy resin binder	2.1.1.1														
			Epoxy grout	2.1.1.2														
			SD-08 Manufacturer’s Instructions															

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		03 01 30.71	Epoxy	2.1.1														
		03 11 14.00 10	SD-02 Shop Drawings															
			Shop Drawings	1.4														
			SD-03 Product Data															
			Materials	2.1														
			SD-04 Samples															
			Sample Panels	1.5														
			SD-06 Test Reports															
			Inspection	3.3														
			Formwork Not Supporting Weight	3.2.1														
			of Concrete															
		03 15 13.00 10	SD-02 Shop Drawings															
			Waterstops	2.4														
			SD-03 Product Data															
			Preformed Expansion Joint Filler	2.2														
			Sealant	2.3														
			Waterstops	2.4														
			SD-04 Samples															
			Lubricant for Preformed	2.3.2														
			Compression Seals															
			Non-metallic Materials	2.4.2														
			SD-07 Certificates															
			Preformed Expansion Joint Filler	2.2														
			Sealant	2.3														
			Waterstops	2.4														
		03 20 01.00 10	SD-02 Shop Drawings															

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		03 20 01.00 10	Reinforcement	3.1														
			SD-03 Product Data															
			Welding	1.3														
			SD-07 Certificates															
			Reinforcing Steel	2.3														
		03 30 00	SD-02 Shop Drawings															
			Fabrication Drawings	1.6.2.1														
			Formwork	1.6.2.2														
			Formwork	1.6.2.2														
			Column Forms	1.6.2.1														
			Wall Forms	1.6.2.1														
			Floor Forms	1.6.2.1														
			Ceiling Forms	1.6.2.1														
			Special Construction	1.6.2.1														
			Reinforcing steel	1.6.2.3														
			SD-03 Product Data															
			Materials for curing concrete	2.4.7														
			Joint sealants	2.4.10														
			Joint filler	2.4.9														
			Plastic Forms	2.1.2														
			Carton Forms	2.1.3														
			Recycled Aggregate Materials	2.4.3.3														
			Cement	2.4.1														
			Portland Cement	2.4.1.3														
			Ready-Mix Concrete	2.3.3														

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		03 30 00	Water-Vapor Barrier Subgrade	2.4.6.1														
			Cover															
			Bonding Materials	2.6														
			Floor Finish Materials	2.7														
			Concrete Curing Materials	2.3.4														
			Reinforcement	2.5														
			Reinforcement Materials	1.6.2.1														
			Liquid Chemical Floor Hardener	2.7.1														
			Vapor retarder	2.4.6														
			Vapor barrier	2.4.6														
			Epoxy bonding compound	2.4.11														
			Synthetic reinforcing fibers	2.5.5														
			Waterstops	2.2.1														
			Waterstops	2.4.10.3														
			Waterstops	3.14.2														
			Wood Forms	2.1.1														
			Local/Regional Materials	1.8.1														
			Biodegradable Form Release	2.4.12														
			Agent															
			SD-04 Samples															
			Dumbbell Type	2.4.10.3														
			Rubber	2.4.10.3														
			Polyvinylchloride (PVC)	2.4.10.3														
			SD-05 Design Data															
			mix design	2.3.2														
			Calculations	1.6.1.1														

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		03 30 00	SD-06 Test Reports															
			Concrete mix design	1.6.4.1														
			Fly ash	1.6.4.2														
			Pozzolan	1.6.4.2														
			Ground granulated blast-furnace	1.6.4.3														
			slag															
			Aggregates	1.6.4.4														
			Fiber-reinforced concrete	1.6.4.5														
			Tolerance report	3.10.2.1														
			Compressive strength tests	3.12.2.3														
			Unit weight of structural	3.12.2.5														
			lightweight concrete															
			Ion concentration	3.12.2.6														
			Air Content	3.12.2.4														
			Slump	2.8.4														
			Air Entrainment	2.8.1														
			SD-07 Certificates															
			Curing concrete elements	1.6.3.1														
			Pumping concrete	1.6.3.2														
			Silica fume manufacturer's	1.6.3.3														
			representative															
			Finishing plan	1.6.3.4														
			Form removal schedule	1.6.3.5														
			Biodegradable Form Release	2.4.12														
			Agent															

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		03 30 00	VOC Content for form release	1.6.3.6														
			agents, curing compounds, and															
			concrete penetrating sealers															
			Material Safety Data Sheets	1.6.3.7														
			Forest Stewardship Council															
			(FSC) Certification															
			SD-08 Manufacturer’s Instructions															
			Fly ash	1.6.4.2														
			Ground granulated blast-furnace	1.6.4.3														
			slag															
		03 52 00	SD-03 Product Data															
			Performance requirements	3.1														
			SD-06 Test Reports															
			Performance requirements	3.1														
			SD-07 Certificates															
			Fabricator's Compatibility	1.7.1														
			Certificates															
			SD-08 Manufacturer’s Instructions															
			Application	3.5														
		04 20 00	SD-02 Shop Drawings															
			Structural Masonry	1.5														
			SD-03 Product Data															
			Local/Regional Materials	1.7.1														
			Environmental Data	1.7.2														
			Clay or Shale Brick	2.2														
			Concrete Brick	2.3														

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		04 20 00	Concrete Masonry Units (CMU)	2.4														
			Cement															
			Insulation	2.14														
			Flashing	2.16														
			Water-Repellant Admixture	2.8														
			Cold Weather Installation	3.1.2														
			Salvaged Brick															
			SD-04 Samples															
			Concrete Masonry Units (CMU)	2.4														
			Concrete Brick	2.3														
			Stone Items															
			Clay or Shale Brick	2.2														
			Anchors, Ties, and Bar	2.10														
			Positioners															
			Expansion-Joint Materials	2.15														
			Joint Reinforcement	2.11														
			Insulation	2.14														
			Portable Panel	1.3														
			SD-05 Design Data															
			Pre-mixed Mortar	2.7.3														
			Unit Strength Method															
			SD-06 Test Reports															
			Efflorescence Test	3.23.3														
			Field Testing of Mortar	3.23.1														
			Field Testing of Grout	3.23.2														
			Prism tests	3.23.4														

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		04 20 00	Masonry Cement															
			Fire-rated CMU	2.4.3														
			Special Inspection	1.5.1														
			SD-07 Certificates															
			Clay or Shale Brick	2.2														
			Concrete Brick	2.3														
			Concrete Masonry Units (CMU)	2.4														
			Control Joint Keys	2.13														
			Anchors, Ties, and Bar	2.10														
			Positioners															
			Expansion-Joint Materials	2.15														
			Joint Reinforcement	2.11														
			Reinforcing Steel Bars and Rods	2.12														
			Masonry Cement															
			Mortar Coloring	2.7.1														
			Insulation	2.14														
			Insulation	2.14														
			Precast Concrete Items	2.5														
			Admixtures for Masonry Mortar															
			Admixtures for Grout	2.9.1														
			Contamination															
			SD-08 Manufacturer’s Instructions															
			Masonry Cement															
			SD-10 Operation and Maintenance															
			Data															
			Plastic Identification															

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		04 21 13.13	SD-02 Shop Drawings															
			Detail Drawings	1.6														
			SD-04 Samples															
			Expansion Joint Materials	2.12														
			Clay or Shale Brick	2.1.1														
			Concrete Masonry Unit	2.1.2														
			Prefaced Concrete Masonry Unit	2.1.3														
			Sample Panel	1.3														
			SD-06 Test Reports															
			Calculations	3.1														
			SD-07 Certificates															
			Clay or Shale Brick	2.1.1														
			Concrete Masonry Unit	2.1.2														
			Joint Reinforcement	2.3														
			Expansion Joint Materials	2.12														
			Insulation	2.5														
			Exterior Sheathing	2.7														
			Moisture Barrier	2.8.1														
			Vapor Retarder	2.8.2														
			Veneer Anchors	2.9														
			Welding	2.10.2														
		05 05 23	SD-03 Product Data															
			Welding Procedure Qualifications	1.5														
			Welder, Welding Operator, and	1.6														
			Tacker Qualification															
			Inspector Qualification	1.7														

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		05 05 23	Previous Qualifications	1.5.2														
			Pre-qualified Procedures	1.5.3														
			SD-06 Test Reports															
			Quality Control	3.2														
			Nondestructive Examination	3.3.1														
			SD-07 Certificates															
			Certified Welding Procedure	1.5.1														
			Specifications (WPS)															
			Certified Brazing Procedure	1.5.1														
			Specifications (BPS)															
			Certified Procedure Qualification	1.5.1														
			Records (PQR)															
			Certified Welder Performance															
			Qualifications (WPQ)															
			Certified Brazer Performance															
			Qualifications (BPQ)															
		05 12 00	SD-02 Shop Drawings															
			Erection Plan	1.7.2.2														
			Fabrication drawings	1.7.1														
			SD-03 Product Data															
			Shop primer	2.4														
			Welding electrodes and rods	2.3.1														
			Load indicator washers	2.2.5														
			Non-Shrink Grout	2.3.2														
			Load indicator bolts															
			SD-06 Test Reports															

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		05 12 00	Class B coating	2.4														
			Bolts, nuts, and washers	2.2														
			SD-07 Certificates															
			Steel	2.1														
			Bolts, nuts, and washers	2.2														
			Galvanizing	2.5														
			Pins and rollers	2.3.4														
			AISC Quality Certification	1.5														
			Overhead, top running crane rail	1.7.2.1														
			beam															
			Welding procedures and	1.7.2.3														
			qualifications															
		05 21 19	SD-01 Preconstruction Submittals															
			Welder qualification	1.5.2														
			Material Safety Data Sheet	1.5.2														
			SD-02 Shop Drawings															
			Steel joist framing	1.5.1														
			SD-06 Test Reports															
			Erection inspection	3.4.1														
			Welding inspections	3.4.1														
			SD-07 Certificates															
			Accessories	2.1														
			Certification of Compliance	1.5.2														
		05 30 00	SD-02 Shop Drawings															
			Fabrication Drawings	1.3.5														
			Metal Floor Deck Units	2.3.1.1														

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		05 30 00	Metal Floor Deck Units	2.3.1.1														
			Metal Floor Deck Units	2.3.2														
			Cant Strips	2.3.4.1														
			Ridge and Valley Plates	2.3.4.2														
			Metal Closure Strips	2.3.4.3														
			SD-03 Product Data															
			Accessories	2.2														
			Deck Units	2.3.1														
			Galvanizing Repair Paint	2.1.3.1														
			Galvanizing Repair Paint	2.1.6														
			Joint Sealant Material	2.1.5														
			Mechanical Fasteners															
			Metal Floor Deck Units	2.3.1.1														
			Metal Floor Deck Units	2.3.1.1														
			Metal Floor Deck Units	2.3.2														
			Piston Tool Operator	1.3.2														
			Repair Paint	2.3.7														
			Sound Absorbing Material															
			Welder Qualifications	1.3.3														
			Welding Equipment	1.3.3														
			Welding Rods and Accessories	1.3.3														
			SD-04 Samples															
			Metal Roof Deck Units	2.3														
			Flexible Closure Strips	2.1.7														
			Flexible Closure Strips	2.3														
			SD-05 Design Data															

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		05 30 00	Deck Units	2.3.1														
			SD-07 Certificates															
			Welding Procedures	1.3.3														
			Fire Safety	1.3.4.1														
			Wind Storm Resistance	1.3.4.2														
		05 40 00	SD-02 Shop Drawings															
			Framing Components	1.6.1														
			SD-03 Product Data															
			studs,joists	2.1														
			SD-05 Design Data															
			Metal framing calculations	1.6.2														
			SD-07 Certificates															
			Load-bearing cold-formed metal framing	1.4														
			Welds	3.1.1														
		05 50 00	SD-02 Shop Drawings															
			steel stairs	2.17														
			structural steel door frames	2.18														
			Access doors and panels	2.3														
			Cover plates and frames	2.5														
			Expansion joint covers	2.6														
			Floor gratings and roof walkways	2.8														
			Handrails	2.11														
			Ladders	2.12														
			Wheel guards	2.19														
			Window and door guards															

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		05 50 00	Ship's ladder	2.12.2														
			angles and plates	2.13														
			Roof hatch	3.14														
			SD-03 Product Data															
			Access doors and panels	2.3														
			Cover plates and frames	2.5														
			Control-joint covers	2.4														
			Expansion joint covers	2.6														
			Floor gratings and roof walkways	2.8														
			Handrails	2.11														
			Ladders	2.12														
			Steel stairs	2.17														
			Steel Stairs, circular															
			Structural steel door frames	2.18														
			Wheel guards	2.19														
			Window and door guards															
			Ship's ladder	2.12.2														
			Roof hatch	3.14														
			SD-04 Samples															
			Expansion joint covers	2.6														
			Control-joint covers	2.4														
		06 10 00	SD-02 Shop Drawings															
			Structural glued laminated	2.2.3														
			Trussed rafters	2.5.3														
			Trussed joists	2.5.4														
			Fabricated structural members	1.9.1														

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		06 10 00	Modifications of structural	1.9.2														
			members															
			Nailing Strips	2.5.5.1														
			SD-05 Design Data															
			Modifications of structural	1.9.2														
			members															
			SD-06 Test Reports															
			Preservative-treated	1.4.5														
			SD-07 Certificates															
			Forest Stewardship Council															
			(FSC) Certification															
			Certificates of grade	1.9.3														
			Preservative treatment	1.7														
			SD-10 Operation and Maintenance															
			Data															
			Plastic	1.4.8														
			Take-back program															
		06 17 00	SD-02 Shop Drawings															
			Shop and Erection Drawings	1.3.1														
			SD-07 Certificates															
			connector plates	2.1.2														
			Prefabricated metal accessories	2.1.4														
			truss members	2.1.1.2														
		06 18 00	SD-02 Shop Drawings															
			Fabrication Drawings	1.3														
			Fabrication Drawings	1.6														

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		06 18 00	Installation Drawings	1.3														
			Installation Drawings	1.6														
			SD-03 Product Data															
			Manufacturer's Catalog Data	1.7														
			SD-04 Samples															
			Exposed-to-View Surfaces	2.3														
			SD-07 Certificates															
			Glue-Laminated Structural Units	2.2														
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	1.7														
			Laminated Wood Materials	1.7														
			Adhesive	1.7														
		06 20 00	SD-02 Shop Drawings															
			Detail Drawings	1.3														
			SD-03 Product Data															
			Siding	2.1.12														
			Wood	2.1.12.7														
			SD-04 Samples															
			Siding	2.1.12														
			Wood Shingles	2.4														
			Moldings															
			Fascias and Trim	2.3														
			SD-07 Certificates															
			Certificates of grade	1.4														
			Certificates of compliance	1.4														
		06 41 16.00 10	SD-02 Shop Drawings															

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		06 41 16.00 10	Shop Drawings	1.5														
			Shop Drawings	1.8														
			Installation	3.1														
			SD-03 Product Data															
			Wood Materials	2.1														
			Wood Finishes	2.9														
			Finish Schedule	2.11.8.3														
			SD-04 Samples															
			Plastic Laminates	2.3														
			Cabinet Hardware	2.6														
			SD-07 Certificates															
			Quality Assurance	1.4														
			Laminate Clad Casework	2.9														
			Laminate Clad Casework	3.1														
		06 61 16	SD-02 Shop Drawings															
			Detail Drawings	1.7														
			Installation	3.2														
			SD-03 Product Data															
			Solid polymer material	2.1														
			Qualifications	1.6														
			Fabrications	2.3														
			SD-04 Samples															
			Material	2.1														
			Counter and Vanity Tops	2.3.6														
			SD-06 Test Reports															
			Solid polymer material	2.1														

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		06 61 16	SD-07 Certificates																
			Fabrications	2.3															
			Qualifications	1.6															
			SD-10 Operation and Maintenance																
			Data																
			Clean-up	3.3															
		07 14 00	SD-03 Product Data																
			Fluid-applied membrane	2.1															
			Membrane primer	2.2															
			Elastomeric sheet	2.8															
			Flexible foam-backed elastomeric sheet	2.10															
			Solvent	3.3															
			Moisture meter	3.4.1															
			Protection board	2.11															
			Bond breaker	2.7															
		07 16 19	SD-04 Samples																
			Metallic waterproofing	1.4															
			SD-06 Test Reports																
			Iron content	1.3															
			Oxidizing agent content	1.3															
			SD-08 Manufacturer’s Instructions																
			Mixing	3.3															
		07 17 00	SD-08 Manufacturer’s Instructions																
			Application	3.2															
			Protection	3.3															

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		07 17 00	Corrections	3.4														
		07 19 00	SD-03 Product Data															
			Water repellents	2.2														
			SD-06 Test Reports															
			Water absorption	1.3.2														
			Water absorption	2.3.1														
			Water absorption	2.3.2														
			Water absorption	2.3.3														
			Accelerated weathering	2.3.1														
			Accelerated weathering	2.3.2														
			Accelerated weathering	2.3.3														
			Accelerated weathering	2.3.4														
			Resistance to chloride ion	2.3.1														
			penetration															
			Resistance to chloride ion	2.3.2														
			penetration															
			Resistance to chloride ion	2.3.3														
			penetration															
			Resistance to chloride ion	2.3.4														
			penetration															
			Moisture vapor transmission	1.3.2														
			Moisture vapor transmission	2.3.1														
			Moisture vapor transmission	2.3.2														
			Moisture vapor transmission	2.3.3														
			Moisture vapor transmission	2.3.4														
			Scaling resistance	2.3.1														

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		07 19 00	Scaling resistance	2.3.2														
			Scaling resistance	2.3.3														
			Scaling resistance	2.3.4														
			Water Penetration and Leakage	1.3.2														
			SD-07 Certificates															
			Manufacturer's qualifications	1.3.1														
			Applicator's qualifications	1.3.1														
			Evidence of acceptable variation	1.3.3														
			Warranty	1.12														
			SD-08 Manufacturer’s Instructions															
			Application	3.4														
			material safety data sheets	1.7.1														
		07 21 13	SD-03 Product Data															
			Block or board insulation	2.1														
			Vapor retarder	2.2														
			Pressure sensitive tape	2.3														
			Protection board or coating	2.4														
			Accessories	2.5														
			SD-08 Manufacturer’s Instructions															
			Block or Board Insulation	2.1														
			Adhesive	2.5.1														
		07 21 16	SD-03 Product Data															
			Blanket insulation	2.1														
			Sill sealer insulation	2.2														
			Vapor retarder	2.4														
			Pressure sensitive tape	2.5														

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		07 21 16	Accessories	2.6														
			SD-08 Manufacturer's Instructions															
			Insulation	3.3.1														
		07 21 23	SD-03 Product Data															
			Loose fill insulation	2.1														
			Sill sealer insulation	2.2														
			Vapor retarder	2.4														
			Pressure sensitive tape	2.5														
			SD-08 Manufacturer's Instructions															
			Loose Fill Insulation	2.1														
		07 22 00	SD-02 Shop Drawings															
			Wood nailers	2.7														
			Tapered roof insulation	2.1.5														
			SD-03 Product Data															
			Fasteners	2.6														
			Asphalt	2.3.3														
			Insulation	2.1														
			SD-06 Test Reports															
			Flame spread and smoke	1.4.1														
			developed ratings															
			SD-07 Certificates															
			qualifications	1.3														
			SD-08 Manufacturer's Instructions															
			fasteners	2.6														
			insulation	2.1														
		07 24 00	SD-02 Shop Drawings															

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		07 24 00	Shop drawings	3.3															
			SD-03 Product Data																
			Sheathing board	2.2															
			Thermal insulation	2.6															
			Adhesive	2.3															
			Mechanical Fasteners	2.5															
			Accessories	2.12															
			Base coat	2.7															
			Portland cement	2.8															
			Reinforcing fabric	2.9															
			Finish coat	2.10															
			Joint Sealant	2.13															
			Sealant Primer	2.11															
			Bond breaker	2.14															
			Backer Rod	2.15															
			Insulation Board	1.4.5															
			Warranty	1.7															
			SD-04 Samples																
			Sample Boards	1.2.3.7															
			Mock-up Installation of EIFS	1.2.1.4															
			SD-05 Design Data																
			Wind load	1.2.1.2															
			Moisture analysis	1.2.4															
			SD-06 Test Reports																
			Abrasion resistance	1.2.3.1															
			Accelerated weathering	1.2.3.2															

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		07 24 00	Impact resistance	1.2.2.3														
			Mildew resistance	1.2.3.3														
			Salt spray resistance	1.2.3.4														
			vapor transmission	1.2.4														
			Absorption-freeze-thaw	1.2.3.6														
			wall fire test	1.2.1.3														
			Water penetration	1.2.1.1														
			Water resistance	1.2.3.5														
			Full scale or intermediate scale	1.2.1.3														
			fire test															
			Surface Burning Characteristics	1.2.2.1														
			Radiant heat	1.2.2.2														
			substrate	3.1														
			Wind load	1.2.1.2														
			SD-07 Certificates															
			Qualifications of EIFS	1.4.1														
			Manufacturer															
			Qualification of EIFS Installer	1.4.2														
			Qualification of Sealant	1.4.3														
			Applicator															
			Qualifications of Third Party	1.4.4														
			Inspector															
			Inspection Check List	3.5.2														
			SD-08 Manufacturer’s Instructions															
			Installation	3.3														

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		07 24 00	SD-10 Operation and Maintenance																
			Data																
			EIFS	1.7															
		07 31 13	SD-03 Product Data																
			Shingles	2.1.1															
			SD-04 Samples																
			Shingles	2.1.1															
			Color charts	2.1.1															
			SD-08 Manufacturer’s Instructions																
			Application	3.3															
		07 40 00	SD-04 Samples																
			Custom trim shapes	2.4															
			SD-07 Certificates																
			Vinyl siding	2.1															
			Inside corner posts	2.2															
			Outside corner posts	2.2															
			'J' channels	2.2															
			Sill trim	2.2															
			accessories	2.4															
		07 41 13	SD-02 Shop Drawings																
			Roofing Panels	1.4.5															
			Flashing and Accessories	1.4.5															
			Gutter/Downspout Assembly	1.4.5															
			SD-03 Product Data																
			Roof panels	2.1															

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		07 41 13	FACTORY-APPLIED COLOR FINISH	1.4.5														
			Accessories	2.4														
			Fasteners	1.4.5														
			Pressure Sensitive Tape	1.4.5														
			UNDERLAYMENTS	2.7														
			Gaskets and Sealing/Insulating Compounds	2.8														
			Coil Stock	1.4.5														
			Aluminized Steel Repair Paint	1.4.5														
			Enamel Repair Paint	1.4.5														
			Galvanizing Repair Paint	1.4.5														
			SD-04 Samples															
			Roof Panels	2.1														
			Factory-applied Color Finish	1.4.5														
			Accessories	2.4														
			Fasteners	1.4.5														
			Gaskets and Sealant/Insulating Compounds	1.4.5														
			SD-05 Design Data															
			Wind Uplift Resistance	1.2.1.2														
			SD-06 Test Reports															
			Leakage Test Report	1.2.1.1														
			Wind Uplift Test Report	1.2.1.2														
			Fire Rating Test Report	2.6.2														

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		07 41 13	Factory Finish and Color	2.2															
			Performance Requirements																
			SD-07 Certificates																
			Roof Panels	2.1															
			Coil stock compatibility	1.4.5															
			Self-Adhering Modified Bitumen	2.7.2															
			Underlayment																
			Qualification of Manufacturer	1.4.1															
			Qualification of Applicator	1.4.2															
			SD-08 Manufacturer’s Instructions																
			INSTALLATION MANUAL	1.4.5															
			SD-09 Manufacturer’s Field																
			Reports																
			Manufacturer's Field Inspection	3.10.1															
			Reports																
			SD-11 Closeout Submittals																
			Warranties	1.8															
			Information Card	3.11															
			Date Of Installation Wall-Mounted	3.12															
			Placard																
		07 42 13	SD-01 Preconstruction Submittals																
			Qualification of Manufacturer	1.5.3															
			Qualification of Installer	1.5.1															
			Qualification of Welders	1.5.1															
			Sample Warranty	1.5.1															
			SD-02 Shop Drawings																

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		07 42 13	Installation Drawings	1.5.1.1														
			SD-03 Product Data															
			sustainable acquisition	1.5.1														
			Factory Color Finish	2.2.3														
			Closure Materials	1.5.5														
			Pressure Sensitive Tape	2.5.4.4														
			Sealants and Caulking	2.5.4.1														
			Galvanizing Repair Paint	1.5.3.1														
			Enamel Repair Paint	1.5.3.1														
			Aluminized Steel Repair Paint	2.7														
			Accessories	1.5.5														
			SD-04 Samples															
			Wall Panels, 12 inches long by	1.5.1														
			actual panel width															
			Fasteners	1.5.3.1														
			Metal Closure Strips, 10 inches	1.5.1														
			long of each type															
			color charts and chips	1.5.1														
			SD-05 Design Data															
			wind load design analysis	1.5.1.2														
			SD-06 Test Reports															
			Leakage Tests	3.7.2														
			Wind Load Tests	1.3.2														
			Coatings and Base Metal Tests	1.5.1														
			Chalking Tests	1.5.1														
			Seismic Tests	1.3.2														

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		07 42 13	SD-07 Certificates																
			Coil Stock	1.5.3.1															
			Fasteners	1.5.3.1															
			Galvanizing Repair Paint	1.5.3.1															
			Enamel Repair Paint	1.5.3.1															
			SD-08 Manufacturer’s Instructions																
			Installation of Wall panels	1.5.1															
			SD-09 Manufacturer’s Field																
			Reports																
			Manufacturer's Field Reports	3.8.1															
			SD-11 Closeout Submittals																
			Warranty	1.8															
			Maintenance Instructions	1.5.1															
			20 year 'No Dollar Limit' warranty	1.8.1															
			for labor and material																
		07 42 63	SD-01 Preconstruction Submittals																
			Qualification of Manufacturer	1.5.3															
			Qualification of Installer	1.5.4															
			Qualifications for Welding Work	1.5.4.1															
			SD-02 Shop Drawings																
			Fabrication and Installation	1.5.1															
			drawings																
			Wall Panel Assemblies	1.5.1															
			Flashing and Accessories	1.5.1															
			Anchorage Systems	1.5.1															
			SD-03 Product Data																

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		07 42 63	sustainable acquisition	1.5.1														
			Manufacturer's catalog data	1.5.1														
			Factory Color Finish	1.5.1														
			Sub-girts and Formed Shapes	1.5.1														
			Closure Materials	1.5.1														
			Insulation	1.5.1														
			Pressure Sensitive Tape	1.5.1														
			Sealants and Caulking	2.4.4.1														
			Rated Wall Assembly	1.5.1														
			Galvanizing Repair Paint	1.5.1														
			Enamel Repair Paint	1.5.1														
			Aluminized Steel Repair Paint	1.5.1														
			Accessories	1.5.1														
			SD-04 Samples															
			Wall Panel Assemblies	1.5.1														
			Fasteners	1.5.1														
			Metal Closure Strips	1.5.1														
			Insulation	1.5.1														
			manufacturer's color charts and chips	1.5.1														
			SD-05 Design Data															
			wind design analysis	1.5.1														
			SD-06 Test Reports															
			Leakage Tests	3.7.2														
			wind load tests	1.3.2														
			seismic tests	1.3.2														

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		07 42 63	Factory Color Finish	1.5.1														
			SD-07 Certificates															
			Fasteners	1.5.1														
			Galvanizing Repair Paint	1.5.1														
			Enamel Repair Paint	1.5.1														
			Qualification of Manufacturer	1.5.3														
			Qualification of Installer	1.5.4														
			wall system assembly wind load	1.5.1														
			and fire rating classification listings															
			SD-08 Manufacturer's Instructions															
			Installation of Wall panels	1.5.1														
			SD-11 Closeout Submittals															
			Warranty	1.5.1														
			Instructions	1.5.1														
			Material Safety Data Sheets	1.5.1														
			20 year 'No-Dollar-Limit' warranty	1.5.1														
		07 52 00	SD-02 Shop Drawings															
			Roof plan	1.4.5														
			SD-03 Product Data															
			Modified Bitumen Sheets	2.1														
			Asphalt	2.3														
			Cold-Applied Membrane	2.4														
			Adhesive															
			Fiberglass Felt	2.1														
			Primer	2.6														
			Modified Bitumen Roof Cement	2.7														

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		07 52 00	re-Manufactured Accessories															
			Fasteners And Plates	2.9														
			Vapor Pressure Relief Vents	2.10.1														
			Warranty	1.9														
			SD-05 Design Data															
			Wind Uplift Calculations	1.4.4														
			SD-07 Certificates															
			Qualification of Manufacturer	1.4.1														
			Qualification of Applicator	1.4.2														
			Qualification of Engineer of Record															
			Bill of Lading	1.5.1														
			Wind Uplift Resistance	1.4.4														
			Fire Resistance	1.4.3														
			SD-08 Manufacturer’s Instructions															
			Modified Bitumen Membrane Application	3.3.6														
			Flashing	3.3.7														
			Temperature Limitations for Asphalt	3.2.3.1														
			Torches	3.2.2.2														
			Cold Adhesive Applied Modified Bitumen Membrane	3.3.3.3														
			Primer	2.6														
			Roof Cement	3.3.11														
			Fasteners	2.9.1														

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		07 52 00	Ventilating Base Sheets	3.3.4														
			Coating Application	3.3.12.2														
			Cold Weather Installation	1.6														
			SD-11 Closeout Submittals															
			Warranty	1.9														
			Information Card	3.8														
			Instructions To Government,	3.7														
			Contractor Personnel															
		07 53 80	SD-02 Shop Drawings															
			CPA sheet	2.1.1														
			SD-03 Product Data															
			CPA sheet	2.1.1														
			Adhesive	2.1.3														
			Sealant	2.1.4														
			Flashing and flashing	2.1.5														
			accessories															
			Fasteners and plates	2.1.6														
			Roof insulation	2.1.8														
			SD-07 Certificates															
			Qualifications of applicator	1.3.1														
			Qualifications of manufacturer	1.3.2														
			SD-08 Manufacturer's Instructions															
			CPA sheet	2.1.1														
			Flashing and flashing	2.1.5														
			accessories															
			Water cutoff mastic	2.1.4														

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		07 53 80	Fasteners and plates	2.1.6														
			SD-11 Closeout Submittals															
			Information card	1.2.1														
			Instructions to Government	1.2.2														
			personnel															
		07 54 19	SD-02 Shop Drawings															
			Roofing System	1.3.2														
			SD-03 Product Data															
			Installation	3.3														
			Protection of Finished Roofing	3.5														
			Inspection	3.6														
			SD-07 Certificates															
			Materials	1.3.1														
			Qualifications	1.3.5														
		07 60 00	SD-02 Shop Drawings															
			Covering on flat, sloped, or	3.1.25														
			curved surfaces															
			Gutters	3.1.17														
			Downspouts	3.1.18														
			Expansion joints	3.1.26														
			Gravel stops and fascias	3.1.15														
			Splash pans	3.1.22														
			Flashing for roof drains	3.1.19														
			Base flashing	3.1.11														
			Counterflashing	3.1.12														
			Flashing at roof penetrations	3.1.27														

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		07 60 00	Reglets	3.1.13															
			Scuppers	3.1.20															
			Copings	3.1.30															
			Drip edge	3.1.16															
			Conductor heads	3.1.21															
			Open valley flashing	3.1.23															
			Eave flashing	3.1.24															
			SD-11 Closeout Submittals																
			Quality Control Plan	3.5															
		07 61 00	SD-07 Certificates																
			Exposed Sheet Metal Items	2.1.1															
			Fasteners	2.1.2.2															
			Aluminum Alloy Sheet and Plate	2.1.2															
			Finish	2.1.2.1															
		07 62 00	SD-02 Shop Drawings																
			Edge strip	3.1.3															
		07 72 00	SD-03 Product Data																
			Ventilators	2.1															
		07 84 00	SD-02 Shop Drawings																
			Firestopping Materials	2.1															
			SD-07 Certificates																
			Firestopping Materials	2.1															
			Installer Qualifications	1.5															
			Inspection	3.3															
		07 92 00	SD-03 Product Data																
			Sealants	2.1															

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		07 92 00	Primers	2.2														
			Bond breakers	2.3														
			Backstops	2.4														
			SD-07 Certificates															
			Sealant	3.3.6														
		08 11 13	SD-02 Shop Drawings															
			Doors	2.1														
			Doors	2.1														
			Frames	2.6														
			Frames	2.6														
			Accessories	2.4														
			Weatherstripping	2.8														
			SD-03 Product Data															
			Doors	2.1														
			Frames	2.6														
			Accessories	2.4														
			Weatherstripping	2.8														
		08 11 16	SD-02 Shop Drawings															
			Doors and frames	2.1														
			SD-08 Manufacturer’s Instructions															
			Doors and frames	2.1														
		08 14 00	SD-02 Shop Drawings															
			Doors	2.1														
			SD-03 Product Data															
			Doors	2.1														
			Accessories	2.2														

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		08 14 00	Water-resistant sealer	2.3.5														
			warranty	1.4														
			Sound transmission class rating															
			Fire resistance rating	2.1.2														
		08 33 13	SD-02 Shop Drawings															
			Detail Drawings	1.4														
			SD-03 Product Data															
			Rolling Counter Doors	1.3														
			Installation	3.1														
			Cleaning	3.3														
			SD-10 Operation and Maintenance															
			Data															
			Rolling Counter Door	2.2														
			(Non-Rated)															
			Fire-Rated Rolling Counter Door	2.3														
		08 34 02	SD-02 Shop Drawings															
			Installation	3.3														
			SD-03 Product Data															
			Bullet Resistant Components	1.5														
			Bifold Doors															
			SD-07 Certificates															
			Bullet Resistant Components	1.5														
			SD-10 Operation and Maintenance															
			Data															
			Bullet Resistant Components	1.5														
		08 34 53.00 40	SD-02 Shop Drawings															

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		08 34 53.00 40	Vault-Door Units	2.1														
			Hardware	2.2														
			Frames and Sills	2.3														
			Day Gate	2.5														
			SD-03 Product Data															
			Doors	2.2														
			Frames and Sills	2.3														
			Day Gate	2.5														
			SD-07 Certificates															
			Doors	2.2														
			Hardware	2.2														
			Frames and Sills	2.3														
			Day Gate	2.5														
		08 34 59	SD-02 Shop Drawings															
			Vault door Unit	1.3														
			Day gate	2.2														
			SD-03 Product Data															
			Vault Door and Frame	2.1														
			SD-07 Certificates															
			Vault Door and Frame	2.1														
			SD-08 Manufacturer’s Instructions															
			Installation	3.1														
		08 36 13	SD-02 Shop Drawings															
			Doors	2.2														
			SD-03 Product Data															
			Doors	2.2														

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		08 36 13	Electric operators	2.6														
			SD-08 Manufacturer’s Instructions															
			Doors	2.2														
			SD-10 Operation and Maintenance															
			Data															
			Doors	2.2														
		08 39 54	SD-02 Shop Drawings															
			Installation	3.1														
			SD-03 Product Data															
			Door Description	1.3														
			Door Description	1.3														
			Design Requirements	1.3.1														
			Manufacturer's Field Service	3.3														
			SD-06 Test Reports															
			Tests	3.2														
			Tests, Inspections, and	2.6														
			Verifications															
			Fire Rating Test and Inspection	2.6.6														
			Prototype Static Test	2.6.1														
			Prototype Blast Test	2.6.2														
			SD-07 Certificates															
			Materials	2.1														
			Fire-Rated Door Assemblies	2.6.6														
			Thermal Insulation	2.4.3														
			Sound Rating Test	2.6.5														

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		08 39 54	SD-10 Operation and Maintenance															
			Data															
			Door Description	1.3														
		08 41 00	SD-02 Shop Drawings															
			Components	2.3														
			SD-03 Product Data															
			Components	2.3														
			SD-04 Samples															
			Components	2.3														
			SD-07 Certificates															
			Components	2.3														
		08 51 13	SD-02 Shop Drawings															
			Windows	2.1														
			Fabrication Drawings	1.10														
			SD-03 Product Data															
			Windows	2.1														
			Windows	2.1														
			Hardware	2.2.8.1														
			Fasteners	2.2.3														
			Fasteners	2.2.8.2														
			Aluminum Windows	1.11														
			Frames	2.1.1.1														
			Frames	2.1.1.3														
			Frames	2.1.4.1														
			Frames	2.1.4.3														
			Aluminum Sills	2.1.4.8														

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		08 51 13	THERMAL-BARRIER WINDOWS	2.4														
			MULLIONS	2.5														
			SHADE SCREENS															
			WINDOW CLEANERS' BOLTS															
			Screens	2.2.10														
			Screens	2.6														
			Weatherstripping	2.2.2														
			Accessories	2.2.8														
			Adhesives	2.2.4														
			Local/Regional Materials	1.7.1														
			Environmental Data	1.7.2														
			SD-04 Samples															
			Finish Sample	1.4.2.1														
			Window Sample	1.4.2.2														
			SD-05 Design Data															
			Structural calculations for	2.1														
			deflection															
			Design Analysis															
			SD-06 Test Reports															
			Minimum condensation															
			resistance factor															
			Resistance to forced entry															
			SD-10 Operation and Maintenance															
			Data															
			Windows	2.1														
			Plastic Identification	1.7.3														

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		08 56 53	SD-02 Shop Drawings																
			Window units	2.1															
			SD-03 Product Data																
			Window units	2.1															
			Hardware	2.5.8															
			Setting materials	2.4															
			Weatherstripping	2.2															
			SD-04 Samples																
			Window units	2.1															
			SD-08 Manufacturer’s Instructions																
			Glass	2.3															
			SD-10 Operation and Maintenance																
			Data																
			Window units	2.1															
		08 71 00	SD-02 Shop Drawings																
			Hardware schedule	1.3															
			Keying system	2.3.8															
			SD-03 Product Data																
			Hardware items	2.3															
			SD-08 Manufacturer’s Instructions																
			Installation	3.1															
			SD-10 Operation and Maintenance																
			Data																
			Hardware Schedule	1.3															
			SD-11 Closeout Submittals																
			Key Bitting	1.4															

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		08 81 00	SD-02 Shop Drawings																
			Installation	3.3.1															
			Control Tower Insulating Glass	2.2.2.1															
			SD-03 Product Data																
			Insulating Glass	1.7.1															
			Plastic Glazing																
			Glazing Accessories	1.3															
			Local/Regional Materials	1.6.1															
			Environmental Data	1.6.2															
			SD-04 Samples																
			Insulating Glass	1.7.1															
			Plastic Sheet																
			Glazing Compound	2.4.2															
			Tape																
			Sealant	2.4.3.1															
			SD-07 Certificates																
			Insulating Glass	1.7.1															
			Plastic Glazing																
			Control Tower Insulating Glass	2.2.2.1															
			Glazing Accessories	1.3															
			SD-08 Manufacturer’s Instructions																
			Setting and sealing materials	2.4															
			Glass setting	3.2															
			SD-11 Closeout Submittals																
			Local/Regional Materials	1.6.1															
		08 91 00	SD-02 Shop Drawings																

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		08 91 00	Wall louvers	1.4															
			Wall louvers	1.5															
			SD-03 Product Data																
			Metal Wall Louvers	2.2															
			SD-04 Samples																
			Wall louvers	1.4															
			Wall louvers	1.5															
			Door louvers	1.5															
			Door louvers	2.3															
		09 06 90	SD-04 Samples																
			Color Schedule	2.2															
		09 15 00	SD-07 Certificates																
			Gypsum Plaster	2.1															
			Gypsum Wallboard	2.1															
			Screws	2.1															
			Stucco/Portland cement lime	2.2															
			plaster																
			Ready-Mixed Plaster or Stucco	2.4															
		09 17 00	SD-07 Certificates																
			Skim coat	2.1															
			SD-08 Manufacturer’s Instructions																
			Skim coat	2.1															
		09 22 00	SD-02 Shop Drawings																
			Metal support systems	2.1															
		09 24 23	SD-02 Shop Drawings																
			Lath	3.3															

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		09 24 23	SD-03 Product Data															
			Materials	1.3														
			SD-04 Samples															
			Colored Stucco Finish Coat	2.2														
			Sample Panel	1.5														
		09 27 00	SD-07 Certificates															
			Skim coat	2.1														
			SD-08 Manufacturer's Instructions															
			Skim coat	2.1														
		09 29 00	SD-03 Product Data															
			Cementitious backer units	2.1.8														
			Glass Mat Water-Resistant	2.1.4														
			Gypsum Tile Backing Board															
			Water-Resistant Gypsum	2.1.3														
			Backing Board															
			Glass Mat Covered or Reinforced	2.1.5														
			Gypsum Sheathing															
			Glass Mat Covered or Reinforced	2.1.5.1														
			Gypsum Sheathing Sealant															
			Impact Resistant Gypsum Board	2.1.6														
			Accessories	2.1.14														
			Gypsum Board	2.1.1														
			Adhesives	2.1.11														
			Joint Treatment Materials	2.1.9														
			Local/Regional Materials	1.5.1														
			Environmental Data	1.5.2														

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		09 29 00	SD-04 Samples															
			Predecorated gypsum board	2.1.7														
			SD-07 Certificates															
			Asbestos Free Materials	2.1														
			SD-08 Manufacturer’s Instructions															
			Material Safety Data Sheets	2.1														
			SD-10 Operation and Maintenance															
			Data															
			Manufacturer maintenance	2.1														
			instructions															
			Waste Management	3.9														
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.5.1														
			Gypsum Board	2.1.1														
			Adhesives	2.1.11														
		09 29 10	SD-03 Product Data															
			Cement board	2.1														
			Fasteners	2.3														
			Joint reinforcement	2.7														
			Sealants	2.5														
			Accessories	2.4														
		09 30 00	SD-02 Shop Drawings															
			Detail Drawings	1.8														
			SD-03 Product Data															
			Local/Regional Materials	1.5.1														
			Environmental Data	1.5.2														

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		09 30 00	Tile	2.1														
			Tile	2.1														
			Setting-Bed	2.2														
			Mortar, Grout, and Adhesive	2.4														
			Reinforcing Wire Fabric	2.2.6														
			SD-04 Samples															
			Tile	2.1														
			Accessories	2.1.8														
			Marble Thresholds	2.5														
			Grout	2.4														
			SD-06 Test Reports															
			Testing	3.7														
			SD-07 Certificates															
			Tile	2.1														
			Mortar, Grout, and Adhesive	2.4														
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.5.1														
			Tile	2.1														
			Reinforcing Wire Fabric	2.2.6														
			Adhesives	2.4														
		09 51 00	SD-02 Shop Drawings															
			Approved Detail Drawings	1.3														
			SD-03 Product Data															
			Acoustical Ceiling Systems	1.3.1														
			SD-04 Samples															
			Acoustical Units	2.1														

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		09 51 00	Acoustic Ceiling Tiles	2.1.1															
			SD-06 Test Reports																
			Fire Resistive Ceilings	1.3.1															
			Ceiling Attenuation Class and																
			Test																
			SD-07 Certificates																
			Acoustical Units	2.1															
			Acoustic Ceiling Tiles	2.1.1															
		09 64 66	SD-02 Shop Drawings																
			Hardwood strip flooring	2.1															
			SD-03 Product Data																
			Hardwood strip flooring	2.1															
			SD-04 Samples																
			Strip flooring	2.2.1															
			Hardwood base	2.2.2															
			Molded-rubber base	2.2.3															
			Steel channels and clips	2.2.5															
			Fiberboard underlayment	2.2.6															
			Flexible foam underlayment	2.2.8															
			Cushions and pads	2.2.7															
			Corkboard or corkroll	2.2.21															
			Sleepers and nailers	2.2.15															
			SD-06 Test Reports																
			Preservative treatment	2.2.15															
			SD-08 Manufacturer’s Instructions																
			system	2.1															

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		09 64 66	Adhesive	3.2.1															
			SD-10 Operation and Maintenance																
			Data																
			strip flooring	2.2.1															
		09 65 00	SD-02 Shop Drawings																
			Resilient Flooring and	2.16															
			Accessories																
			SD-03 Product Data																
			Resilient Flooring and	2.16															
			Accessories																
			Adhesives	2.12															
			Vinyl Composition Tile	2.1															
			Sheet Vinyl Flooring	2.2															
			Rubber Tile	2.3															
			Rubber Sheet Flooring	2.4															
			Solid Vinyl Tile	2.5															
			Cement-Fiber Board																
			Local/Regional Materials	1.6.1															
			Environmental Data	1.6.2															
			Sheet Linoleum	2.6															
			Linoleum Tile																
			Cork																
			SD-04 Samples																
			Resilient Flooring and	2.16															
			Accessories																
			SD-06 Test Reports																

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		09 65 00	Moisture, Alkalinity and Bond Tests	3.3														
			SD-08 Manufacturer's Instructions															
			Surface Preparation	3.2														
			Installation	3.1														
			SD-10 Operation and Maintenance Data															
			Resilient Flooring and Accessories	2.16														
			SD-11 Closeout Submittals															
			Local/Regional Materials	1.6.1														
			Resilient Flooring and Accessories	2.16														
			Adhesives	2.12														
			Sheet Linoleum	2.6														
			Linoleum Tile															
			Cork															
		09 65 66	SD-02 Shop Drawings															
			Approved Detail Drawings	3.3.6.1														
			SD-03 Product Data															
			Installation	3.3														
			SD-04 Samples															
			Flooring	1.3														
			SD-07 Certificates															
			Materials	1.4														
		09 68 00	SD-02 Shop Drawings															

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		09 68 00	Installation	3.4														
			Molding	2.7														
			SD-03 Product Data															
			Carpet	2.1														
			Carpet Pads	2.3														
			Carpet Moldings	2.4														
			Base	2.5														
			Surface Preparation	3.1														
			Installation	3.4														
			Regulatory Requirements	1.3														
			Physical Characteristics	2.1.2														
			Local/Regional Materials	1.6.1														
			Environmental Data	1.6.2														
			SD-04 Samples															
			Carpet	2.1														
			Molding	2.7														
			SD-06 Test Reports															
			Moisture and Alkalinity Tests	3.2														
			SD-07 Certificates															
			Carpet	2.1														
			Regulatory Requirements	1.3														
			SD-10 Operation and Maintenance															
			Data															
			Carpet	2.1														
			Cleaning and Protection	3.5														
			Operational Service	1.9														

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		09 68 00	SD-11 Closeout Submittals															
			Local/Regional Materials	1.6.1														
			Carpet	2.1														
			Carpet	2.1														
			Carpet	2.1														
			Adhesives and Concrete Primer	2.6														
		09 90 00	SD-02 Shop Drawings															
			Piping identification	3.12														
			stencil	3.12														
			SD-03 Product Data															
			Local/Regional Materials	1.9.1														
			Environmental Data	1.9.2														
			Materials	2.1														
			Coating	2.1														
			Manufacturer's Technical Data	2.1														
			Sheets															
			Sealant	3.3.5														
			SD-04 Samples															
			Color	1.11														
			Textured Wall Coating System	1.4.2														
			Sample Textured Wall Coating	1.4.3														
			System Mock-Up															
			SD-07 Certificates															
			Applicator's qualifications	1.3														
			Qualification Testing	1.4.1.2														
			SD-08 Manufacturer’s Instructions															

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		09 90 00	Application instructions	3.4.1														
			Mixing	3.8.2														
			Manufacturer's Material Safety	1.7.2														
			Data Sheets															
			SD-10 Operation and Maintenance															
			Data															
			Coatings:	2.1														
		09 96 00	SD-01 Preconstruction Submittals															
			Material, Equipment and Fixture	1.3														
			List															
			SD-03 Product Data															
			Heat-Resistant Coatings	2.1														
			Epoxy Coatings	2.2														
			Polyurethane Coatings	2.3														
			Chlorinated-Rubber Coatings	2.4														
			SD-04 Samples															
			Color Chips	1.3														
			SD-07 Certificates															
			Heat-Resistant Coatings	2.1														
			Epoxy Coatings	2.2														
			Polyurethane Coatings	2.3														
			Chlorinated-Rubber Coatings	2.4														
		09 97 13.00 40	SD-01 Preconstruction Submittals															
			Material, Equipment, and Fixture	1.4														
			Lists															
			Safety Plan	1.4														

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		09 97 13.00 40	SD-03 Product Data															
			Abrasive Blasting Material	2.1														
			Sealant Compound	2.2														
			Inorganic Zinc	2.3.1														
			Inhibitive Polyamide Epoxy	2.3.1														
			Aliphatic Polyurethane	2.3.1														
			SD-04 Samples															
			Manufacturer's Standard Color	1.4														
			Charts															
			Inspection Forms	3.5														
			SD-05 Design Data															
			Mix Designs	1.4														
			Inorganic Zinc	2.3.1														
			Inhibitive Polyamide Epoxy	2.3.1														
			Aliphatic Polyurethane	2.3.1														
			SD-06 Test Reports															
			Inspection reports	3.5														
			SD-07 Certificates															
			Abrasive Blasting Material	2.1														
			Sealant Compound	2.2														
			Inorganic Zinc Coating	3.2.1														
			Inhibitive Polyamide Epoxy	2.3.1														
			Aliphatic Polyurethane	2.3.1														
			SD-08 Manufacturer’s Instructions															
			Protective Coatings	2.3														
		09 97 13.27	SD-05 Design Data															

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		09 97 13.27	Containment System	1.4.4.1														
			SD-06 Test Reports															
			Joint Sealant Qualification Test	1.4.5.1														
			Reports															
			Coatings Qualification Test	1.4.5.2														
			Reports															
			Metallic Abrasive Qualification	1.4.5.3														
			Test Reports															
			Coating Sample Test Reports	3.2.3														
			Abrasive Sample Test Reports	3.2.4														
			Inspection Report Forms	3.9.2.2														
			Daily Inspection Reports	3.9.2.3														
			Recycled Metallic Abrasive Field	1.4.5.4														
			Test Reports (Daily and Weekly)															
			SD-07 Certificates															
			Contract Errors, Omissions, and	1.4.1														
			Other Discrepancies															
			Corrective Action Procedures	1.4.2.1														
			Coating Work Plan	1.4.3														
			Qualifications of Certified	1.4.6.1														
			Industrial Hygienist (CIH)															
			Qualifications Of Individuals	1.4.6.5														
			Performing Abrasive Blasting															
			Qualifications of Certified	1.4.6.2														
			Protective Coatings Specialist															
			(PCS)															

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY						
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		09 97 13.27	Qualifications of Coating	1.4.6.3														
			Inspection Company															
			Qualifications of QC Specialist	1.4.6.4														
			Coating Inspector															
			Qualifications of Testing	1.4.6.6														
			Laboratory for Coatings															
			Qualifications of Testing	1.4.6.7														
			Laboratory for Abrasive															
			Qualifications of Coating	1.4.6.8														
			Contractors															
			Joint Sealant Materials	1.4.6.9														
			Coating Materials	1.4.6.10														
			Coating System Component	1.4.6.11														
			Compatibility															
			Non-metallic Abrasive	1.4.6.12														
			Metallic Abrasive	1.4.6.13														
			SD-08 Manufacturer’s Instructions															
			Joint Sealant Instructions	1.5.1														
			Coating System Instructions	1.5.2														
			SD-11 Closeout Submittals															
			Disposal of Used Abrasive	3.6.6														
			Inspection Logbook	3.9.2.4														
		10 14 01	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1														
			SD-03 Product Data															
			Modular Exterior Signage System	2.1														

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		10 14 01	Installation	3.1															
			Exterior Signage	1.3															
			Wind Load Requirements	1.4															
			SD-04 Samples																
			Exterior Signage	1.3															
			SD-10 Operation and Maintenance																
			Data																
			Protection and Cleaning	3.1.2															
		10 14 02	SD-02 Shop Drawings																
			Detail Drawings	3.1															
			SD-03 Product Data																
			Installation	3.1															
			SD-04 Samples																
			Interior Signage	1.3															
			SD-10 Operation and Maintenance																
			Data																
			Approved Manufacturer's	3.1															
			Instructions																
			Protection and Cleaning	3.1.2															
		10 22 13	SD-02 Shop Drawings																
			Wire mesh partitions	1.4															
			SD-03 Product Data																
			Wire mesh partitions	1.4															
		10 28 13	SD-03 Product Data																
			Finishes	2.1.2															
			Accessory Items	2.2															

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		10 28 13	SD-04 Samples															
			Finishes	2.1.2														
			Accessory Items	2.2														
			SD-07 Certificates															
			Accessory Items	2.2														
			SD-10 Operation and Maintenance															
			Data															
			Electric Hand Dryer	2.2.26														
		10 44 16	SD-01 Preconstruction Submittals															
			Manufacturer's Data	2.1														
			SD-02 Shop Drawings															
			Fire Extinguishers	2.1														
			Accessories															
			Cabinets	2.4														
			Wall Brackets	2.5														
			SD-03 Product Data															
			Fire Extinguishers	2.1														
			Accessories															
			Cabinets	2.4														
			Wall Brackets	2.5														
			Replacement Parts	3.2.1														
			SD-04 Samples															
			Fire Extinguisher	2.1														
			Cabinet	2.1														
			Wall Brackets	2.5														
			Accessories															

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		10 44 16	SD-07 Certificates															
			Fire Extinguishers	2.1														
			Manufacturer's Warranty with	2.1														
			Inspection Tag															
		10 51 13	SD-02 Shop Drawings															
			Types	2.1														
			Location	1.4														
			Installation	3.1														
			Numbering system	3.2														
			SD-03 Product Data															
			Material	2.2														
			Locking Devices	2.3.1														
			Lock Control Chart															
			Handles	2.3.4														
			Finish	2.2.2														
			components	2.3														
			Assembly	3.1														
			SD-04 Samples															
			Color chips	1.5.1														
		12 21 00	SD-02 Shop Drawings															
			Hardware	2.1														
			Installation	3.2														
			SD-03 Product Data															
			Window Blinds	2.1														
			Hardware	2.1														
			Installation	3.2														

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		12 21 00	SD-04 Samples															
			Window Blinds	2.1														
			Hardware	2.1														
			Valance															
			SD-06 Test Reports															
			Window Blinds	2.1														
			SD-08 Manufacturer's Instructions															
			Window Blinds	2.1														
			SD-10 Operation and Maintenance															
			Data															
			Window Blinds	2.1														
		12 32 00	SD-02 Shop Drawings															
			Fabrication	2.3														
			Fabrication	2.4														
			Fabrication	2.5														
			Fabrication	2.6														
			Installation Drawings	3.2														
			SD-03 Product Data															
			Cabinets	2.9														
			Corrosion-Resistant Steel	2.2														
			Plywood	2.2														
			Hardwood	2.2														
			Glass	2.2														
			Adhesives	2.2														
			Filler Material	2.2														
			Particle Board	2.2														

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		12 32 00	Turpentine	2.2														
			Varnish	2.2														
			Fasteners	2.2														
			Steel Sinks	2.2														
			Service Fixtures	2.2														
			Accessories and Hardware	2.2														
			Accessories and Hardware	2.8														
			Softwoods	2.2														
			Plastic Laminate	2.2														
			Countertops	2.9														
			SD-04 Samples															
			Accessories and Hardware	2.2														
			Accessories and Hardware	2.8														
			Manufacturer's Standard Color	2.1														
			Charts															
			SD-07 Certificates															
			Corrosion-Resistant Steel	2.2														
			Plywood	2.2														
			Hardwood	2.2														
			Glass	2.2														
			Adhesives	2.2														
			Filler Material	2.2														
			Particle Board	2.2														
			Turpentine	2.2														
			Varnish	2.2														
			Fasteners	2.2														

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		12 32 00	Steel Sinks	2.2														
			Service Fixtures	2.2														
			Accessories and Hardware	2.2														
			Accessories and Hardware	2.8														
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	2.1														
		12 36 00	SD-02 Shop Drawings															
			Fabrication	2.3														
			Installation Drawings	3.1														
			SD-03 Product Data															
			Corrosion-Resistant Steel	2.2														
			Plywood	2.2														
			Hardwood	2.2														
			Granite	2.3														
			Granite	2.3														
			Marble	2.3														
			Marble	2.3														
			Synthetic resins	2.3														
			Synthetic resins	2.3														
			Stainless steel	2.3														
			Stainless steel	2.3														
			Tile	2.3														
			Tile	2.3														
			FRP															
			Adhesives	2.2														
			Filler Material	2.2														

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		12 36 00	Particle Board															
			Turpentine	2.2														
			Varnish	2.2														
			Fasteners	2.2														
			Steel Sinks	2.2														
			Service Fixtures	2.2														
			Accessories and Hardware	2.5														
			Softwoods	2.2														
			Plastic Laminate	2.2														
			SD-04 Samples															
			Counter Top	2.3														
			Back Splash,	2.3														
			Accessories and Hardware	2.5														
			Manufacturer's Standard Color	2.1														
			Charts															
			SD-07 Certificates															
			Corrosion-Resistant Steel	2.2														
			Plywood	2.2														
			Hardwood	2.2														
			Adhesives	2.2														
			Filler Material	2.2														
			Particle Board															
			Turpentine	2.2														
			Varnish	2.2														
			Fasteners	2.2														
			Steel Sinks	2.2														

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		12 36 00	Service Fixtures	2.2															
			Accessories and Hardware	2.5															
			SD-08 Manufacturer’s Instructions																
			Manufacturer's Instructions	2.1															
		12 93 00	SD-02 Shop Drawings																
			Benches and Chairs	2.5															
			Tables	2.10															
			Shelters	2.9															
			Bicycle Racks	2.6															
			Planters	2.8															
			Bollards	2.7															
			Tree Grates	2.11															
			Assembly Instruction Drawings	1.5.3															
			SD-03 Product Data																
			Benches and Chairs	2.5															
			Tables	2.10															
			Shelters	2.9															
			Bicycle Racks	2.6															
			Planters	2.8															
			Bollards	2.7															
			Tree Grates	2.11															
			Waste Receptacles	2.8															
			SD-04 Samples																
			Finish	2.3.4															
			SD-06 Test Reports																
			Recycled Materials	2.1.12															

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		12 93 00	Testing	3.3														
			SD-07 Certificates															
			Primer certificate	1.5.4														
			Powder coatings certificate	1.5.5														
		21 13 13.00 20	SD-02 Shop Drawings															
			Shop Drawings	1.5.2														
			SD-03 Product Data															
			Pipe	2.2.1														
			Pipe	2.2.4														
			Fittings	2.2.1														
			Alarm valves	2.2.8														
			Valves	2.2.6														
			Water motor alarms	2.2.9														
			Sprinklers	2.2.5														
			Pipe hangars and supports	2.2.7														
			Sprinkler Alarm Switches	2.3.1														
			Fire department connections	2.2.10														
			Excess pressure pump	2.2.12														
			Mechanical couplings	2.2.1														
			Backflow Prevention Assembly	2.2.11														
			Seismic Bracing	2.2.7														
			SD-05 Design Data															
			Hydraulic Calculations	1.3														
			SD-06 Test Reports															
			request to schedule Preliminary	3.6														
			Tests															

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		21 13 13.00 20	Preliminary Test Report	3.6														
			request to schedule Final	3.7														
			Acceptance Test															
			Final Acceptance Test Report	3.7														
			SD-07 Certificates															
			Inspection by Fire Protection	3.1														
			Engineer															
			Fire Protection Engineer	1.5.1														
			Sprinkler System Installer	1.5.2														
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.8														
			Instructions															
			SD-11 Closeout Submittals															
			As-built drawings	3.7														
			On-site training	3.8														
		21 13 16.00 20	SD-02 Shop Drawings															
			Sprinkler heads and piping	1.3.8														
			system layout															
			Electrical wiring diagrams	1.3.8														
			SD-03 Product Data															
			Piping	2.1														
			Valves	2.1.10														
			Water motor alarms	2.1.5														
			Sprinkler heads	2.1.2														
			Pipe hangers and supports	2.1.9														

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		21 13 16.00 20	Fire department connections	2.1.14														
			Low air pressure supervisory	2.1.7														
			switch															
			Dry pipe valves	2.1.4														
			Air compressor	2.1.8														
			Mechanical couplings	2.1.1														
			Backflow Preventers	2.1.10.1														
			Pressure Switch	2.1.6														
			SD-05 Design Data															
			Sprinkler system design	1.3														
			SD-06 Test Reports															
			Preliminary tests	3.2.1														
			SD-07 Certificates															
			Qualifications of installer	1.5.1														
			SD-10 Operation and Maintenance															
			Data															
			Dry pipe valves	2.1.4														
			Air compressor	2.1.8														
			SD-11 Closeout Submittals															
			As-built drawings of each system	1.3.9														
		22 00 00	SD-02 Shop Drawings															
			Plumbing System	3.9.1														
			SD-03 Product Data															
			Fixtures	2.4														
			Flush valve water closets	2.4.3														
			Flush valve urinals	2.4.4														

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		22 00 00	Pressure Assist water closets	2.4.6														
			Wall hung lavatories	2.4.7														
			Countertop lavatories	2.4.8														
			Kitchen sinks	2.4.9														
			Service sinks	2.4.10														
			Drinking-water coolers	2.4.11														
			Plastic shower stalls	2.4.14														
			Plastic bathtub liners	2.4.15														
			Plastic bathtub wall surrounds	2.4.16														
			Water heaters	2.10														
			Pumps	2.12														
			Backflow prevention assemblies	3.9.1.1														
			Shower Faucets	2.6.2														
			Welding	1.5.1														
			Vibration-Absorbing Features	3.4														
			SD-06 Test Reports															
			Tests, Flushing and Disinfection	3.9														
			Test of Backflow Prevention	3.9.1.1														
			Assemblies															
			SD-07 Certificates															
			Materials and Equipment	1.3														
			Bolts	2.1.1														
			SD-10 Operation and Maintenance															
			Data															
			Plumbing System	3.9.1														
		23 05 92	SD-06 Test Reports															

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		23 05 92	Certified TAB Report	1.4.1														
		23 07 00	SD-03 Product Data															
			Piping insulation	2.1														
			Piping insulation finishes	2.1.9														
			Heating, ventilating, and air	2.2														
			conditioning systems insulation															
			Duct insulation finishes	2.2.6														
			Accessory materials	2.6														
			Adhesives, sealants, and coating	2.5														
			compounds															
		23 09 54	SD-02 Shop Drawings															
			List of Symbols and	1.7.4.2														
			Abbreviations Used on Drawings															
			List of I/O Points	1.7.4.3														
			Equipment Components List	1.7.4.4														
			AC Power Table	1.7.4.5														
			Control system schematic	1.4.1.1														
			Ladder diagrams	1.4.1.2														
			Component wiring diagrams	1.4.1.3														
			Terminal strip diagrams	1.4.1.4														
			Communication architecture	1.4.1.5														
			schematic															
			SD-03 Product Data															
			DDC hardware	1.7.1.1														
			DDC capabilities	1.7.1.2														
			Workstation software	1.7.1.3														

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		23 09 54	Input devices	1.7.1.4														
			Output devices	1.7.1.5														
			Surge and transient protection	1.7.1.6														
			Laptop computer	2.4.1														
			Hand-held terminal	1.3.7														
			Smoke detectors	2.9.1														
			Pneumatic tubing	2.11.7														
			SD-06 Test Reports															
			Field tests	3.3.3														
			Performance verification tests	3.3.4														
			SD-07 Certificates															
			Contractors Qualifications	1.7.5														
			Training	3.4														
			Pressure Tank Certification	1.7.6														
			SD-10 Operation and Maintenance															
			Data															
			Controls and HVAC System	1.7.10														
			Operators Manual															
			DDC Manufacturer's Hardware	1.7.12														
			and Software Manuals															
			SD-11 Closeout Submittals															
			Air compressors	2.11.1														
			Refrigerated air dryer	2.11.4														
			Training course documentation	1.7.7														
			Service organizations	1.7.8														
			Contractor certification	1.7.9														

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		23 73 33	SD-02 Shop Drawings															
			Temperature control systems	1.3.1														
			Automatic Flow Control Valves	1.3.2														
			(AFCV)															
			Equipment layout drawings	1.3.3														
			SD-03 Product Data															
			Packaged air-conditioners	2.1.1														
			Split-system air-conditioners	2.1.2														
			Packaged heat pumps	2.1.3														
			Split-system heat pumps	2.1.4														
			air-handling units	2.1.5														
			Multizone air-handling units	2.1.6														
			Air-cooled water chillers	2.1.7														
			Air-cooled condensing units	2.1.8														
			Room fan-coil air-conditioners	2.1.9														
			Room air-conditioners	2.1.10														
			Packaged terminal	2.1.11														
			air-conditioners															
			Packaged terminal heat pumps	2.1.12														
			Computer room air-conditioners	2.1.13														
			Series fan powered variable air	2.1.14														
			volume (VAV) terminals															
			Water-source heat pumps	2.1.15														
			Liquid cooling radiators	2.1.16														
			Cabinet unit heaters	2.1.17														
			Unit heaters	2.1.18														

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		23 73 33	Convectors	2.1.19														
			Finned tube radiation	2.1.20														
			Hot water converters	2.1.21														
			Oil-fired heating boilers	2.1.22														
			Pumps	2.1.23														
			Exhaust fans	2.1.24														
			Exhaust fans	2.1.27														
			Direct vent gas-fired central	2.1.25														
			furnaces															
			Fire dampers	2.3.7														
			Expansion tanks	2.5.10														
			Air separators	2.5.11														
			Heat tape	2.6														
			Pipe hangers and supports	2.5.1														
			Flexible pipe connectors	2.5.8														
			Dampers	2.3.3														
			Diffusers, registers, and grilles	2.3.4														
			Outside air intake louvers	2.3.5														
			Duct heaters	2.3.8														
			Filter boxes	2.3.9														
			Flexible round ducts	2.3.10														
			Duct lining	2.3.11														
			Valves	2.4.7														
			Pipe and fittings	2.4														
			Solids-from-water separator	2.5.14														
			SD-06 Test Reports															

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		23 73 33	Packaged air-conditioners	2.1.1														
			Split-system air-conditioners	2.1.2														
			Packaged heat pumps	2.1.3														
			Split-system heat pumps	2.1.4														
			Water-source heat pumps	2.1.15														
			air-handling units	2.1.5														
			Multizone air-handling units	2.1.6														
			Air-cooled water chillers	2.1.7														
			Series fan powered variable air volume (VAV) terminals	2.1.14														
			Computer room air-conditioners	2.1.13														
			SD-07 Certificates															
			Certification of welders' qualifications	1.3.5														
			Equipment field test plans	1.3.6														
			SD-08 Manufacturer’s Instructions															
			Installation manual	1.3.4														
			SD-10 Operation and Maintenance Data															
			Packaged air-conditioners	2.1.1														
			Split-system air-conditioners	2.1.2														
			Packaged heat pumps	2.1.3														
			Split-system heat pumps	2.1.4														
			air-handling units	2.1.5														
			Multizone air-handling units	2.1.6														
			Air-cooled water chillers	2.1.7														

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		23 73 33	Air-cooled condensing units	2.1.8														
			Room fan-coil air-conditioners	2.1.9														
			Room air-conditioners	2.1.10														
			Packaged terminal	2.1.11														
			air-conditioners															
			Packaged terminal heat pumps	2.1.12														
			Computer room air-conditioners	2.1.13														
			Series fan powered variable air	2.1.14														
			volume (VAV) terminals															
			Water-source heat pumps	2.1.15														
			Liquid cooling radiators	2.1.16														
			Unit heaters	2.1.18														
			Oil-fired heating boilers	2.1.22														
			Pumps	2.1.23														
			Exhaust fans	2.1.24														
			Exhaust fans	2.1.27														
			Direct vent gas-fired central	2.1.25														
			furnaces															
			Fire dampers	2.3.7														
			SD-11 Closeout Submittals															
			Air-cooled condensing units	2.1.8														
			Air-cooled water chillers	2.1.7														
			Air filter inventory	1.3.7														
		26 06 00	SD-02 Shop Drawings															
			Layout and location drawings	1.2.1														
			SD-03 Product Data															

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		26 06 00	Ground rods	2.1														
			Grounding Plates	2.2														
			Bonding and grounding grids	2.3														
			Grounding and bonding	2.4														
			connectors															
			Grounding and bonding	2.5														
			conductors															
			SD-06 Test Reports															
			acceptance checks and tests	3.2.1														
			Ground resistance tests	1.2.2														
		26 08 00	SD-06 Test Reports															
			Acceptance tests and inspections	3.1														
			SD-07 Certificates															
			Qualifications	1.4.1														
			Acceptance test and inspections	1.4.3														
			procedure															
		26 12 19.10	SD-02 Shop Drawings															
			Pad-mounted transformer	1.4.1														
			drawings															
			SD-03 Product Data															
			Pad-mounted transformers	2.2														
			SD-06 Test Reports															
			Acceptance checks and tests	3.6.1														
			SD-07 Certificates															
			Transformer losses	1.4.2														

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		26 12 19.10	SD-09 Manufacturer's Field															
			Reports															
			design tests	2.6.2														
			routine and other tests	2.6.3														
			SD-10 Operation and Maintenance															
			Data															
			Transformer(s)	1.5.1														
			SD-11 Closeout Submittals															
			Transformer test schedule	2.6.1														
		26 12 19.20	SD-02 Shop Drawings															
			Pad-mounted transformer	1.4.1														
			drawings															
			SD-03 Product Data															
			Single-phase pad-mounted	2.2														
			transformers (dead-front)															
			SD-06 Test Reports															
			Acceptance checks and tests	3.6.1														
			SD-07 Certificates															
			Transformer losses	1.4.2														
			SD-09 Manufacturer's Field															
			Reports															
			design tests	2.6.2														
			routine and other tests	2.6.3														
			Silicone compatibility tests	2.3														
			SD-10 Operation and Maintenance															
			Data															

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		26 12 19.20	Transformer(s)	1.5.1														
			SD-11 Closeout Submittals															
			Transformer test schedule	2.6.1														
		26 18 23.00 40	SD-02 Shop Drawings															
			Fabrication Drawings	2.2														
			Installation Drawings	3.1.2														
			SD-03 Product Data															
			Equipment and Performance	1.2														
			Data															
			Surge Arresters	2.3														
			Mounting Brackets	2.5														
			SD-08 Manufacturer’s Instructions															
			Installation Instructions	3.1.1														
			Surge Arresters	2.3														
			SD-10 Operation and Maintenance															
			Data															
			O & M Manuals	2.3.1														
			Surge Arresters	2.3														
		26 20 00	SD-02 Shop Drawings															
			Panelboards	2.13														
			Transformers	2.17														
			Busway	2.4														
			Cable trays	2.5														
			Motor control centers	2.21														
			Wireways	2.27														
			SD-03 Product Data															

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		26 20 00	Receptacles	2.12														
			Circuit breakers	2.13.2														
			Switches	2.11														
			Transformers	2.17														
			Enclosed circuit breakers	2.14														
			Motor controllers	2.19														
			Combination motor controllers	2.21.3														
			Manual motor starters	2.20														
			Metering	2.28														
			Surge protective devices	2.29														
			SD-06 Test Reports															
			600-volt wiring test	3.2.2														
			Grounding system test	3.2.5														
			Transformer tests	3.2.3														
			Ground-fault receptacle test	3.2.4														
			SD-07 Certificates															
			Fuses	2.16														
			SD-09 Manufacturer’s Field															
			Reports															
			Transformer factory tests	2.30.1														
			SD-10 Operation and Maintenance															
			Data															
			Electrical Systems	1.5.1														
			Metering	2.28														
		26 32 13	SD-02 Shop Drawings															

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		26 32 13	Engine-Generator set and	1.5.1.1														
			auxiliary equipment															
			Auxiliary systems	1.5.1.2														
			SD-03 Product Data															
			Engine-generator set data	1.3.1														
			Engine-generator set efficiencies	1.3.2														
			Diesel engine data	1.3.3														
			Generator and exciter data	1.3.4														
			Diesel engine-generator set	2.1														
			Auxiliary systems and equipment	2.2														
			Remote alarm annunciator	2.2.7														
			SD-05 Design Data															
			Capacity calculations for	1.3.5														
			engine-generator set															
			Calculations for brake mean	1.3.6														
			effective pressure															
			Torsional vibration stress	1.3.7														
			analysis computations															
			Capacity calculations for batteries	1.3.8														
			Turbocharger load calculations	1.3.9														
			SD-06 Test Reports															
			Acceptance checks and tests	3.5.1														
			Functional acceptance tests	3.5.2														
			Functional acceptance test	3.4.5														
			procedure															
			SD-07 Certificates															

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		26 32 13	Vibration isolation system	1.5.2														
			Fuel system	1.5.3														
			Start-up engineer	3.3														
			Instructor's	3.6.1														
			SD-09 Manufacturer’s Field															
			Reports															
			Engine tests	2.6.1														
			Generator tests	2.6.2														
			Assembled engine-generator set	2.6.3														
			tests															
			SD-10 Operation and Maintenance															
			Data															
			Diesel engine-generator set	2.1														
			Auxiliary systems and equipment	2.2														
			Preliminary assembled operation	3.4.4														
			and maintenance manuals															
			SD-11 Closeout Submittals															
			Posted operating instructions	1.8.2														
			Training plan	3.6.2														
		26 32 14.00 10	SD-02 Shop Drawings															
			Detailed Drawings	1.4.12														
			Acceptance	3.9														
			SD-03 Product Data															
			Performance Tests	3.5.5														
			Sound Limitations	2.6														
			Generator	2.12														

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		26 32 14.00 10	Integral Main Fuel Storage Tank	2.3.4														
			Day Tank	2.3.5														
			Power Factor	3.5.1.2														
			Heat Exchanger	2.5.2														
			Time-Delay on Alarms	2.16.5														
			Cooling System	2.5														
			Manufacturer's Catalog	2.2														
			Vibration Isolation	1.4.8														
			Instructions	3.8														
			Experience	1.4.9														
			Field Engineer	1.4.10														
			Site Welding	1.4.6														
			General Installation	3.1														
			Site Visit	1.4.4														
			SD-06 Test Reports															
			Onsite Inspection and Tests	3.5														
			SD-07 Certificates															
			Vibration Isolation	1.4.8														
			Prototype Tests	3.3														
			Reliability and Durability	3.5.5.1														
			Emissions	2.9														
			Sound limitations	2.6														
			Current Balance	2.12.1														
			Materials and Equipment	2.1														
			Factory Inspection and Tests	2.25														
			Inspections	3.5.3														

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		26 32 14.00 10	Cooling System	2.5															
		26 32 15	SD-02 Shop Drawings																
			Engine-generator unit and	1.6.3.1															
			auxiliary equipment																
			Engine-generator unit electrical	1.6.3.2															
			drawings																
			SD-03 Product Data																
			Engine-generator set	1.4.1															
			Diesel engines	2.4															
			exciter	2.5.2.1															
			SD-05 Design Data																
			Torsional vibrations	2.2.2															
			SD-06 Test Reports																
			Preliminary operation	3.3.2															
			Phase relationship tests	3.3.3															
			Control panel	3.3.3															
			Engine-generator set acceptance	3.3.4															
			tests																
			Auxiliary equipment test	3.3.4															
			SD-07 Certificates																
			Diesel engine generator	1.6.4															
			successful operation																
			Field welding procedures	1.6.5															
			SD-09 Manufacturer's Field																
			Reports																
			Engine-generator set tests	2.16.1															

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		26 32 15	SD-10 Operation and Maintenance															
			Data															
			Engine-generator unit and	1.6.3.1														
			auxiliary equipment															
			Engine speed governing system	2.4.3														
			voltage regulator	2.5.2.2														
			Engine control panel	2.10.1.1														
			SD-11 Closeout Submittals															
			Posted operating instructions for	3.2.3														
			diesel engine-generator set															
		26 33 53.00 20	SD-02 Shop Drawings															
			UPS Drawings	1.6.1														
			UPS Installation	1.6.2														
			SD-03 Product Data															
			UPS Module	2.3														
			Factory Testing	2.12														
			UPS System	2.2														
			Spare Parts	1.10.2														
			SD-06 Test Reports															
			Work Plan	1.6.3														
			Factory Test Plan	1.6.4														
			Performance Test Plan	1.6.5														
			Factory Tests	2.12														
			Performance Tests Report	1.6.7														
			Factory Tests Report	1.6.6														

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		26 33 53.00 20	SD-09 Manufacturer's Field															
			Reports															
			Initial Inspection and Tests	3.2.2														
			Performance Tests	3.2.3														
			SD-10 Operation and Maintenance															
			Data															
			UPS Operation and Maintenance	1.10.1														
			SD-11 Closeout Submittals															
			Installation	3.1														
		26 41 00	SD-02 Shop Drawings															
			Overall lightning protection	1.4.1														
			system															
			Each major component	1.4.1														
			SD-03 Product Data															
			Air terminals	2.2.1														
			Conductors	2.1.1														
			Ground rods	2.2.2														
			Connectors	2.2.3														
			Fittings	2.2.4														
			fasteners	2.2.5														
			SD-06 Test Reports															
			Grounding system test	3.5.1														
			Lightning protection system	3.5.2														
			inspection															
			SD-07 Certificates															
			UL listing or label	1.4.2														

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		26 51 00	SD-03 Product Data																
			Fluorescent lighting fixtures	2.1															
			Fluorescent electronic ballasts	1.5.1															
			Fluorescent electromagnetic	2.1.5															
			ballasts																
			Fluorescent lamps	2.1.6															
			High-intensity-discharge (HID)	2.2															
			lighting fixtures																
			HID ballasts	2.2.1															
			High-pressure sodium (HPS)	2.2.2															
			lamps																
			Metal-halide lamps	2.2.3															
			Incandescent lighting fixtures	2.3															
			Incandescent lamps	2.3.1															
			Dimmer switch	2.3.2															
			Lighting contactor	2.7															
			Time switch	2.8															
			Photocell switch	2.9															
			Power hook fixture hangers	2.10															
			Exit signs	2.11															
			Emergency lighting equipment	2.12															
			Central emergency system	2.14															
			Occupancy sensors	2.16															
			Electronic dimming ballast	2.1.2															
			Dimming ballast controls	2.1.3															
			Light Level Sensor	2.1.4															

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		26 51 00	SD-06 Test Reports															
			Operating test	3.2														
			SD-10 Operation and Maintenance															
			Data															
			Lighting Control System	1.5.3														
		26 56 00	SD-02 Shop Drawings															
			Luminaire drawings	1.4.1.1														
			Poles	1.4.1.2														
			SD-03 Product Data															
			Local/Regional Materials	1.6.1														
			Environmental Data	1.6.2														
			Energy Efficiency	1.6.3														
			Luminaires	2.2														
			Lamps	2.2.1														
			Ballasts	2.2.2														
			Lighting contactor	2.3														
			Time switch	2.4														
			Photocell switch	2.5														
			Concrete poles	2.6.1														
			Aluminum poles	2.6.2														
			Steel poles	2.6.3														
			Fiberglass poles	2.6.5														
			Brackets	2.7														
			Auxiliary instant-on quartz system	2.9														
			SD-04 Samples															
			Luminaires	2.2														

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		26 56 00	SD-05 Design Data															
			Design Data for luminaires	1.4.3														
			SD-06 Test Reports															
			Pressure treated wood pole	1.4.2														
			quality															
			Tests for fiberglass poles	1.4.4														
			Operating test	3.2														
			SD-08 Manufacturer's Instructions															
			Concrete poles	2.6.1														
			Fiberglass poles	2.6.5														
			SD-10 Operation and Maintenance															
			Data															
			Operational Service	1.9														
		27 10 00	SD-02 Shop Drawings															
			Telecommunications drawings	1.7.1														
			Distribution frames	2.4														
			SD-03 Product Data															
			Telecommunications cabling	2.3.1														
			Patch panels	2.4.4														
			Telecommunications	2.6														
			outlet/connector assemblies															
			Equipment support frame	2.4.1														
			Building protector assemblies	2.4.2														
			Connector blocks	2.4.3														
			Protector modules	2.4.2.1														
			SD-06 Test Reports															

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		27 10 00	Telecommunications cabling	3.3.1															
			testing																
			Factory reel tests	3.3.1.2															
			SD-07 Certificates																
			Contractor Qualifications	1.7.3.1															
			Manufacturer Qualifications	1.7.3.2															
			Test plan	1.7.4															
			SD-10 Operation and Maintenance																
			Data																
			Telecommunications cabling and	3.1.1															
			pathway system																
		28 31 63.00 20	SD-02 Shop Drawings																
			Battery power calculations	1.5.1															
			SD-03 Product Data																
			Fire alarm control panel (FACP)	2.2.11															
			Printers	2.2.16															
			video display unit (VDU)	2.2.14															
			Terminal cabinets	2.2.10.2															
			Manual stations	2.2.18															
			Transmitters	2.2.23															
			Batteries	2.2.9.1															
			Battery chargers	2.2.9.3															
			Smoke sensors	2.2.6															
			Thermal sensors	2.2.7															
			Wiring	2.2.10.3															
			Wiring	2.4															

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		28 31 63.00 20	Notification appliances	2.2.19														
			Addressable interface devices	2.2.5														
			Graphic annunciator	2.2.15														
			Amplifiers	2.2.13														
			Tone generators	2.2.13														
			Digitalized voice generators	2.2.13														
			Firefighter telephone	2.2.17														
			Waterflow detectors	2.2.21														
			Tamper switches	2.2.20														
			Electromagnetic door holders	2.2.22														
			Remote fire alarm control units	2.2.12														
			Smoke sensor testing procedures	2.2.6.4														
			Radio transmitter and interface	2.2.23.2														
			panels															
			Digital alarm communicator	2.2.23.3														
			transmitter (DACT)															
			Telegraphic transmitter	2.2.23.1														
			SD-07 Certificates															
			Qualifications of installer	1.5.2														
			SD-10 Operation and Maintenance															
			Data															
			INTERIOR FIRE ALARM	2.2														
			SYSTEM															
			Record drawing software	1.5.3														
		31 00 00	SD-01 Preconstruction Submittals															
			Shoring	3.5														

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		31 00 00	Dewatering Work Plan	1.6														
			SD-03 Product Data															
			Utilization of Excavated Materials	3.9														
			Shoulder Construction	3.15														
			SD-06 Test Reports															
			Testing	3.18														
			Borrow Site Testing	2.1														
			SD-07 Certificates															
			Testing	3.18														
		31 11 00	SD-03 Product Data															
			Nonsaleable Materials	3.6.2														
			SD-04 Samples															
			Tree wound paint	2.1														
			Herbicide	2.2														
		31 31 16	SD-03 Product Data															
			Termiticide Application Plan	3.4														
			Termiticides	2.1														
			Foundation Exterior	3.2.3														
			Utilities and Vents	3.2.4														
			Crawl and Plenum Air Spaces	3.2.5														
			Verification of Measurement	3.5														
			Application Equipment	3.4.1														
			Warranty	1.7														
			SD-04 Samples															
			Termiticides	2.1														
			SD-06 Test Reports															

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		31 31 16	Equipment Calibration and Tank	3.4.1														
			Measurement															
			Soil Moisture	3.3.1														
			Quality Assurance	1.8														
			SD-07 Certificates															
			Qualifications	1.3														
		31 32 11	SD-01 Preconstruction Submittals															
			Work sequence schedule	1.8														
			Erosion control plan	1.8														
			Seed Establishment Period	2.5.13.1														
			Maintenance Record	3.6														
			SD-03 Product Data															
			Local/Regional Materials															
			Equipment	1.4														
			Finished Grade	3.1.1														
			Erosion Control Blankets	2.5														
			SD-04 Samples															
			Materials	1.5														
			SD-06 Test Reports															
			Geosynthetic Binders	2.2.2														
			Hydraulic Mulch															
			Geotextile Fabrics	2.4														
			Erosion Control Blankets	2.5														
			Synthetic Grid Systems															
			Articulating Cellular Concrete															
			Block Systems															

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		31 32 11	Sand															
			Gravel															
			SD-07 Certificates															
			Fill Material															
			Mulch	2.3														
			Hydraulic Mulch															
			Geotextile Fabrics	2.4														
			Geosynthetic Binders	2.2.2														
			Synthetic Soil Binders	2.2.1														
			Installer's Qualification	1.7.1														
			Recycled Plastic	2.1														
			Seed	2.5.13														
			Asphalt Adhesive															
			Tackifier															
			Wood By-Products															
			Wood Cellulose Fiber															
			SD-10 Operation and Maintenance															
			Data															
			Maintenance Instructions	3.6.2														
			SD-11 Closeout Submittals															
			Local/Regional Materials															
			Recycled Plastic	2.1														
			Wood Cellulose Fiber															
			Paper Fiber															
			Mulch Control Netting and Filter Fabric	2.3.3														

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		31 32 11	Hydraulic Mulch															
			Erosion Control Blankets Type XI	2.5.11														
			Geotextile Fabrics	2.4														
			Aggregate															
		32 10 00	SD-03 Product Data															
			Precast car stops	2.5														
			Asphalt cement	2.6.3														
			Local/Regional Materials	1.6.1														
			SD-04 Samples															
			cores	3.3														
			SD-06 Test Reports															
			Trial batch	1.4.4														
			Mix design	1.4.5														
			Asphalt concrete	2.1														
			Density	3.3.2.2														
			Density	3.3.2.3														
			Thickness	3.3.2.2														
			Thickness	3.3.2.3														
			Straightedge test	3.3.2.2														
			SD-07 Certificates															
			mix delivery record	1.4.3														
			Asphalt concrete	2.1														
			Asphalt concrete	2.1														
			Curbs															
			Guard (Guide) rails															
			Median barriers															

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		32 10 00	Traffic signs	2.4														
		32 11 24	SD-03 Product Data															
			Aggregates	2.1.1														
			Local/Regional Materials	1.7.1														
			SD-06 Test Reports															
			Gradation	3.6.2.1														
			Gradation	3.6.2.1														
			Bearing ratio	2.1.1														
			Liquid limit	2.1.1														
			Plasticity index	2.1.1														
			Percentage of wear	2.1.1														
			Density	3.6.2.3														
			Density	3.6.2.3														
			Smoothness	3.6.2.2														
			Thickness	3.6.2.5														
		32 12 10	SD-03 Product Data															
			Waybills and Delivery Tickets	1.3.3														
			Local/Regional Materials	1.7														
			SD-06 Test Reports															
			Sampling and Testing															
		32 31 13	SD-02 Shop Drawings															
			Erection/Installation Drawings	1.3														
			Fence Assembly	1.3														
			Location of Gate, Corner, End,	3.17.1														
			and Pull Posts															
			Gate Assembly	1.3														

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		32 31 13	Gate Hardware and Accessories	2.19														
			SD-03 Product Data															
			Fence Assembly	1.3														
			Gate Assembly	1.3														
			Gate Hardware and Accessories	2.19														
			SD-04 Samples															
			Fabric	2.3														
			Fabric	2.4														
			Fabric	3.9														
			Posts	2.5														
			Braces	2.5														
			Line Posts	2.6														
			Sleeves	2.8														
			Top Rail	2.9														
			Bottom Rail	2.11														
			Tension Wire	2.13														
			Tension Wire	3.17.2														
			Stretcher Bars	2.14														
			Gate Posts	2.17														
			Gate Hardware and Accessories	2.19														
			Padlocks	2.24														
			Wire Ties	2.21														
			SD-07 Certificates															
			Zinc Coating	1.5.1														
			Zinc Coating	2.2														
			Zinc Coating	2.13														

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		32 31 13	PVC coating	1.5.1															
			aluminum alloy coating	1.5.1															
			Fabric	2.3															
			Fabric	2.4															
			Fabric	3.9															
			Stretcher Bars	2.14															
			Gate Hardware and Accessories	2.19															
			Concrete	2.22															
			Concrete	3.4															
			SD-08 Manufacturer’s Instructions																
			Fence Assembly	1.3															
			Gate Assembly	1.3															
			Hardware Assembly	1.3															
			Accessories	1.3															
			Accessories	1.3															
		32 92 19	SD-03 Product Data																
			Wood cellulose fiber mulch																
			Fertilizer	2.4															
			SD-06 Test Reports																
			Topsoil composition tests																
			SD-07 Certificates																
			seed	2.1															
			SD-08 Manufacturer’s Instructions																
			Erosion Control Materials	2.7															
		32 92 23	SD-03 Product Data																
			Fertilizer	2.3															

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		32 92 23	SD-06 Test Reports															
			Topsoil composition tests															
			SD-07 Certificates															
			sods	2.1														
		33 11 00	SD-03 Product Data															
			Piping Materials	2.1.1														
			Water distribution main	2.1														
			Water service line	2.2														
			Hydrants	2.1.2.7														
			Indicator posts	2.1.2.8														
			Corporation stops	2.2.2.1														
			Valve boxes	2.1.2.9														
			Valve boxes	2.2.2.10														
			SD-06 Test Reports															
			Disinfection	2.2.2.16														
			SD-07 Certificates															
			Water distribution main	2.1														
			Water service line	2.2														
			Lining	2.1.1.1														
			Lining	2.1.1.2														
			hydrants	2.1.2.7														
			Displacement Type Meters	2.2.2.12														
			Compound Type Meters	2.2.2.13														
			SD-08 Manufacturer’s Instructions															
			Delivery, storage, and handling	1.5														
			Installation	3.1.1														

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		33 20 00	SD-02 Shop Drawings															
			Installation Diagrams	3.13.2														
			SD-03 Product Data															
			Well Installation Plan	1.5.1														
			Well Material	2.1														
			Qualifications	1.5.2														
			Site Conditions	1.7														
			Geophysical Logging	1.5.6														
			SD-06 Test Reports															
			Survey Maps and Notes	3.13.7														
			Well Development Records	3.13.3														
			Geophysical Logs	3.13.4														
			Decommissioning/Abandonment	3.12														
			Records															
			Project Photographs	3.13.6														
			Water Source	3.2.3														
			Filter Pack	2.3														
			Tests	3.5														
			SD-07 Certificates															
			Casing	2.1														
			Cement and Bentonite Grout	2.5														
			Air line and gauge	1.5.1														
			Drilling mud	1.5.1														
			Well Screens	2.2														
			Water removed	2.7														
			Graveling equipment	3.3.4														

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		33 20 00	Construction of Filter Pack	3.3.4															
		33 24 00.10	SD-02 Shop Drawings																
			Equipment	2.2															
			SD-03 Product Data																
			Equipment	2.2															
			Hardware Manual	1.3.1															
			Operator's Manual	1.3.2															
		33 24 00.20	SD-02 Shop Drawings																
			Equipment	2.2															
			SD-03 Product Data																
			Equipment	2.2															
			SD-10 Operation and Maintenance																
			Data																
			Hardware Manual	1.3.1															
			Operator's Manual	1.3.2															
		33 24 00	SD-02 Shop Drawings																
			Materials	2.1															
			Equipment	2.2															
			SD-03 Product Data																
			Equipment	2.2															
			SD-10 Operation and Maintenance																
			Data																
			Hardware Maintenance Manual	1.3.1															
			Operator's Manual	1.3.2															
		33 30 00	SD-01 Preconstruction Submittals																
			Existing Conditions	1.6															

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		33 30 00	SD-02 Shop Drawings																
			Drawings	1.4.2															
			Precast concrete manhole	2.2.1															
			Metal items	2.2.4															
			Frames, covers, and gratings	2.2.4.1															
			SD-03 Product Data																
			Pipeline materials	2.1															
			SD-06 Test Reports																
			Reports	2.3															
		33 40 00	SD-03 Product Data																
			Placing Pipe	3.3															
			SD-04 Samples																
			Pipe for Culverts and Storm	2.1															
			Drains																
			SD-07 Certificates																
			Resin Certification	2.1.9															
			Resin Certification	2.1.10															
			Pipeline Testing	3.8															
			Hydrostatic Test on Watertight	2.7															
			Joints																
			Determination of Density	3.7.5															
			Frame and Cover for Gratings	2.3.6															
		33 63 13	SD-02 Shop Drawings																
			Heat Distribution System design	1.4.4															
			SD-03 Product Data																
			Pipe	2.4.1															

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		33 63 13	Insulation	2.3														
			Fittings	2.4.2														
			Cathodic protection	1.4.1														
			Anchors	1.3.3														
			Expansion joints	2.5														
			Coatings	1.2.9														
			Conduit	2.1.6														
			Field Connection of Casing	2.1.12														
			Sections															
			SD-05 Design Data															
			Pipe-stress and system	1.2.7														
			expansion calculations															
			Cathodic protection system	1.2.8														
			calculations															
			Manufacturer's data sheets	1.2.9														
			SD-07 Certificates															
			Work plan	1.2.10														
			Quality assurance	1.2.11														
			UHDS manufacturer certification	1.2.4														
			UHDS design	1.3.2														
			Certificate of compliance	1.2.12														
			Testing firm qualification	1.2.13														
			Welds	1.2.14														
			SD-10 Operation and Maintenance															
			Data															
			Heat distribution system	1.2.16														

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		33 63 13	SD-11 Closeout Submittals															
			Daily written report	1.2.15														
		33 63 23	SD-03 Product Data															
			Piping	2.1														
			Valves	2.3														
			Strainers	2.4.2														
			Pipe hangers and supports	2.4.1														
			Traps	2.4.3														
			Gages	2.4.4														
			Steam flow meters	2.4.8														
			Expansion joints	2.4.10														
			Manhole drainers	2.6														
			SD-07 Certificates															
			Certification of welder's	1.4.1														
			qualifications															
			SD-10 Operation and Maintenance															
			Data															
			Manhole drainers	2.6														
			Steam flow meters	2.4.8														
		33 70 02.00 10	SD-02 Shop Drawings															
			Detail Drawings	1.4.1														
			As-Built Drawings	1.4.2														
			SD-03 Product Data															
			Fault Current Analysis	2.19.4														
			Protective Device	2.19														
			Coordination Study	2.19.5														

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		33 70 02.00 10	Nameplates	2.2														
			Material and Equipment	2.1														
			Installation Requirements	3.2														
			SD-06 Test Reports															
			Factory Tests	2.17														
			Field Testing	3.12														
			Operating Tests	3.12.13														
			Cable Installation	3.3.1.4														
			SD-07 Certificates															
			Material and Equipment	2.1														
			Cable Joints	3.4														
			Installation Engineer	3.13.2														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.13.1														
			Manuals															
		33 71 01	SD-03 Product Data															
			Conductors	2.6														
			Insulators	2.5														
			Wood Poles	2.2.1														
			Pole top switch	2.16														
			Recloser	2.17														
			Sectionalizer	2.18														
			Cutouts	2.13														
			Transformer	2.15														
			Metering equipment	2.20														

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		33 71 01	Meters	2.20.3														
			Surge arresters	2.12														
			Guy strand	2.8														
			Anchors	2.10														
			SD-06 Test Reports															
			Field Test Plan	1.5.2														
			Field Quality Control	3.3														
			Ground resistance test reports	1.5.1														
			SD-07 Certificates															
			Wood poles	2.2.1														
			Composite crossarms	2.3.1														
			SD-09 Manufacturer's Field															
			Reports															
			routine and other tests	2.23.2														
			SD-11 Closeout Submittals															
			Transformer test schedule	2.23.1														
		33 71 02	SD-02 Shop Drawings															
			precast sectional underground	3.1.5.12														
			duct bank															
			SD-03 Product Data															
			Medium voltage cable	2.1.6														
			Medium voltage cable joints	2.1.8														
			Medium voltage cable	2.1.7														
			terminations															
			Live end caps	2.1.9														
			600 volt wires and cables	2.1.3.1														

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		33 71 02	SD-06 Test Reports															
			Acceptance checks and tests	3.2.1														
			SD-07 Certificates															
			Cable splicer/terminator	3.1.20														
			Cable splicer qualifications	1.5.1														
			SD-08 Manufacturer’s Instructions															
			Ground megger	1.5.2														
			'UL listed' kit	2.1.7														
			Termination kit	3.1.10														
			Medium-voltage joints	3.1.12														
			SD-09 Manufacturer’s Field															
			Reports															
			Medium voltage cable tests	2.2.1														
			heat shrinkable joint kit	1.5.3														
		33 82 00	SD-02 Shop Drawings															
			Telecommunications Outside	1.6.1.1														
			Plant															
			Telecommunications Entrance	1.6.1.2														
			Facility Drawings															
			SD-03 Product Data															
			Wire and cable	2.8														
			Cable splices, and connectors	2.5														
			Closures	2.3														
			Building protector assemblies	2.2.1														
			Protector modules	2.2.2														
			Cross-connect terminal cabinets	2.4														

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CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		33 82 00	Spare Parts	1.8.2															
			SD-06 Test Reports																
			Pre-installation tests	3.5.1															
			Acceptance tests	3.5.2															
			Outside Plant Test Plan	1.6.3															
			SD-07 Certificates																
			Telecommunications Contractor	1.6.2.1															
			Qualifications																
			Key Personnel Qualifications	1.6.2.2															
			SD-08 Manufacturer's Instructions																
			Building protector assembly	2.2.1															
			installation																
			Cable tensions	3.1.8.1															
			Fiber Optic Splices	3.1.10.2															
			SD-09 Manufacturer's Field																
			Reports																
			Factory Reel Test Data	2.16.1															
			SD-10 Operation and Maintenance																
			Data																
			Telecommunications outside	1.6.1.1															
			plant (OSP)																
			SD-11 Closeout Submittals																
			Record Documentation	1.8.1															
		41 65 20	SD-02 Shop Drawings																
			Control relay cabinet	2.2															
			SD-03 Product Data																

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

MULTIPLE AWARD CONSTRUCTION CONTRACT SPECIFICATION

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		41 65 20	Control relay cabinet	2.2														
			Multi-position rotary switches	2.2.2														
			Audio visual alarm	2.2.3														
			Relays	2.2.4														
			Float switch assembly	2.3														
			SD-06 Test Reports															
			Acceptance Tests	3.2														
			SD-07 Certificates															
			Control relay cabinet	2.2														
			SD-10 Operation and Maintenance															
			Data															
			Control relay cabinet	2.2														

SECTION 01 35 29

SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS

06/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z359.1	(1992; R 1999) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.3	(1996) Construction Tower Cranes
ASME B30.5	(2000) Mobile and Locomotive Cranes
ASME B30.8	(2000) Floating Cranes and Floating Derricks
ASME B30.22	(2000) Articulating Boom Cranes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2002) Potable Fire Extinguishers
NFPA 241	(2000) Safeguarding Construction, Alteration, and Demolition Operations
NFPA 51B	(2003) Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2002) National Electrical Code
NFPA 70E	(2004) Electrical Safety in the Workplace

U. S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910.94	Ventilation

29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1919	Gear Certification
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.500	Fall Protection

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP)

Activity Hazard Analysis (AHA)

Crane Critical Lift Plan

Crane Work Plan

Proof of qualifications for Crane Operators

SD-06 Test Reports

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Accident Reports

Monthly Exposure Reports

Regulatory Citations and Violations

Crane Reports

SD-07 Certificates

Confined Space Entry Permit

Certificate of Compliance (Crane)

Third Party Certification of Barge-Mounted Mobile Cranes

Submit one copy of each permit/certificate attached to each Daily Report.

1.3 DEFINITIONS

a. Associate Safety Professional (ASP). An individual who is currently certified by the Board of Certified Safety Professionals.

b. Certified Construction Health & Safety Technician (CHST). An individual who is currently certified as a CHST by the Board of Certified Safety Professionals.

c. Certified Industrial Hygienist (CIH). An individual who is currently certified as a CIH by the American Board of Industrial Hygiene.

d. Certified Safety Professional (CSP). An individual who is currently certified as a CSP by the Board of Certified Safety Professionals.

e. Certified Safety Trained Supervisor (STS). An individual who is currently certified as an STS by the Board of Certified Safety Professionals.

f. Competent Person for Fall Protection. A person who is cabable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

g. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.

h. Low-slope roof. A roof having a slope less than or equal to 4 in 12 (vertical to horizontal).

i. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

j. Multi-Employer Work Site (MEWS). A multi-employer work site, as defined by OSHA, is one in which many employers occupy the same site. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors.

k. Operating Envelope. The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).

l. Qualified Person for Fall Protection. A person with a recognized degree or professional certifictae, extensive knowledge, training and experience in the field of fall protection who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.

m. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

(1) Death, regardless of the time between the injury and death, or the length of the illness;

(2) Days away from work;

(3) Restricted work;

(4) Transfer to another job;

(5) Medical treatment beyond first aid;

(6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

n. Site Safety and Health Officer (SSHO). The superintendent or other qualified or competent person who is responsible for the on-site safety and health required for the project.

o. Steep roof. A roof having a slope greater than 4 in 12 (vertical to horizontal).

p. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.

q. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and collision, including unplanned contact between the load, crane, and/or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.).

1.4 CONTRACTOR SAFETY SELF-EVALUATION CHECKLIST

Contracting Officer will provide a "Contractor Safety Self-Evaluation checklist" to the Contractor at the pre-construction conference. The checklist will be completed monthly by the Contractor and submitted with each request for payment voucher. An acceptable score of 90 or greater is required. Failure to submit the completed safety self-evaluation checklist or achieve a score of at least 90, will result in a retention of up to 10 percent of the voucher.

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, work performed shall comply with USACE EM 385-1-1, and the following laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

1.6 DRUG PREVENTION PROGRAM

Conduct a proactive drug and alcohol use prevention program for all workers, prime and subcontractor, on the site. Ensure that no employee uses illegal drugs or consumes alcohol during work hours. Ensure there are no employees under the influence of drugs or alcohol during work hours.

After accidents, collect blood, urine, or saliva specimens and test the injured and involved employees for the influence of drugs and alcohol. A copy of the test shall be made available to the Contracting Officer upon request.

1.7 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.7.1 Personnel Qualifications

Work performed under this contract shall meet Level 2.

1.7.1.1 Site Safety and Health Officer (SSHO)

Site Safety and Health Officer (SSHO) shall be provided at the work site at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The SSHO shall meet the following requirements:

Level 1:
Worked on similar projects.
10-hour OSHA construction safety class or equivalent within last 3 years.
Competent person training as needed.

Level 2:
A minimum of 3 years safety work on similar project.
30-hour OSHA construction safety class or equivalent within last 3 years.
Competent person training as needed.

Level 3:
A minimum of 5 years safety work on similar projects.
30-hour OSHA construction safety class or equivalent within the last 5 years.
An average of at least 24 hours of formal safety training each year for the past 5 years.
Competent person training as needed.

Level 4:
A minimum of 10 years safety work of a progressive nature with at least 5 years of experience on similar projects.
30-hour OSHA construction safety class or equivalent within the last 5 years.
An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following areas of competency: Excavation; Scaffolding; Fall protection; Hazardous energy; Confined space; Health hazard recognition, evaluation and control of chemical, physical and biological agents; Personal protective equipment and clothing to include selection, use and maintenance.

Level 5:
An Associate Safety Professional (ASP), Certified Safety Trained Supervisor (STS) and/or Construction Health & Safety Technician (CHST).
A minimum of 10 years safety work of a progressive nature with at least 5 years of experience on similar projects.
30-hour OSHA construction safety class or equivalent within the last 5 years.

An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following areas of competency: Excavation; Scaffolding; Fall protection; Hazardous energy; Confined space; Health hazard recognition, evaluation and control of chemical, physical and biological agents; Personal protective equipment and clothing to include selection, use and maintenance.

Level 6: A
Certified Safety Professional (CSP) and/or Certified Industrial Hygienist (CIH).
A minimum of 10 years safety work of a progressive nature with at least 5 years of experience on similar projects.
30-hour OSHA construction safety class or equivalent within the last 5 years.
An average of at least 24 hours of formal safety training each year for the past 5 years with training for competent person status for at least the following areas of competency: Excavation; Scaffolding; Fall protection; Hazardous energy; Confined space; Health hazard recognition, evaluation and control of chemical, physical and biological agents; Personal protective equipment and clothing to include selection, use and maintenance.

1.7.1.2 Certified Safety Professional (CSP) and/or Certified Industrial hygienist (CIH)

Provide a Certified Safety Professional (CSP) and/or Certified Industrial Hygienist (CIH) at the work site to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The CSP and/or CIH shall be the safety and occupational health "competent person" as defined by USACE EM 385-1-1. The CSP and/or CIH shall have no other duties than safety and occupational health management, inspections, and/or industrial hygiene.

1.7.1.3 Associate Safety professional (ASP), Certified Safety Trained Supervisor (STS) and/or Construction Health and Safety Technician (CHST).

Provide an Associate Safety Professional (ASP); Certified Safety Trained Supervisor (STS); and/or Construction Health & Safety Technician (CHST) at the work site to perform safety management, surveillance, inspections, and safety enforcement for the Contractor to meet the designated safety level in paragraph 1.6.1. The ASP, STS, and/or CHST shall be the safety and occupational health "competent person" as defined by USACE EM 385-1-1. The ASP, STS, and/or CHST shall be at the work site at all times whenever work or testing is being performed and shall conduct and document daily safety inspections. The ASP, STS, and/or CHST shall have no other duties other than safety and occupational health management, inspections, and enforcement on this contract.

1.7.1.4 Competent Person for Confined Space Entry

Provide a competent person meeting the requirements of EM 385-1-1 who is assigned in writing by the Designated Authority to assess confined spaces and who possesses demonstrated knowledge, skill and ability to:

a. Identify the structure, location, and designation of confined and permit-required confined spaces where work is done;

b. Calibrate and use testing equipment including but not limited to,

oxygen indicators, combustible gas indicators, carbon monoxide indicators, and carbon dioxide indicators, and to interpret accurately the test results of that equipment;

c. Perform all required tests and inspections specified in 29 CFR 1910.146 and 29 CFR 1915 Subpart B;

d. Assess hazardous conditions including atmospheric hazards in confined space and adjacent spaces and specify the necessary protection and precautions to be taken;

e. Determine ventilation requirements for confined space entries and operations;

f. Assess hazards associated with hot work in confined and adjacent space and determine fire watch requirements; and,

g. Maintain records required.

When the work involves marine operations that handle combustible or hazardous materials, this qualified person shall be a NFPA certified marine chemist.

1.7.1.5 Competent Person for the Health Hazard Control and Respiratory Protection Program

Provide a competent person meeting the requirements of EM 385-1-1 who is:

a. Capable by education, specialized training and/or experience of anticipating, recognizing, and evaluating employee exposure to hazardous chemical, physical and biological agents in accordance with USACE EM 385-1-1, Section 6.

b. Capable of spe cifying necessary controls and protective actions to ensure worker health.

1.7.1.6 Crane Operators

Crane operators shall meet the requirements in USACE EM 385-1-1, Section 16 and Appendix G. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, crane operators shall be designated as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Proof of current qualifications shall be provided.

1.7.2 Personnel Duties

1.7.2.1 Site Safety and Health Officer (SSHO)/Superintendent

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Safety inspection logs shall be attached to the Contractors' daily report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPS and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. A list of unresolved safety and health deficiencies shall be posted on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

h. Ensure an approved "Special Permission Energized Electrical Work Permit" prior to starting any activity on energized electrical systems.

Failure to perform the above duties will result in dismissal of the superintendent and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.7.2.2 Certified Safety Professional (CSP), Certified Industrial Hygienist (CIH), Associate Safety Professional (ASP), Certified Safety Trained Supervisor (STS), and/or Certified Construction Health & Safety Technician (CHST)

a. Perform safety and occupational health management, surveillance, inspections, and safety enforcement for the project.

b. Perform as the safety and occupational health "competent person" as defined by USACE EM 385-1-1.

c. Be on site whenever work or testing is being performed.

d. Conduct and document safety inspections.

e. Shall have no other duties other than safety and occupational health management, inspections, and enforcement on this contract.

If the CSP, CIH, ASP, STS, CHST is appointed as the SSHO all duties of that position shall also be performed.

1.7.3 Meetings

1.7.3.1 Preconstruction Conference

a. The Contractor will be informed, in writing, of the date of the preconstruction conference. The purpose of the preconstruction conference is for the Contractor and the Contracting Officer's representatives to become acquainted and explain the functions and operating procedures of their respective organizations and to reach mutual understanding relative to the administration of the overall project's Accident Prevention Plan (APP) before the initiation of work.

b. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent,

site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

c. The Contractor shall discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, a schedule for the preparation, submittal, review, and acceptance of AHAs shall be established to preclude project delays.

d. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Work shall not begin until there is an accepted APP.

e. The functions of a Preconstruction conference may take place at the Post-Awqrd Kickoff meeting for Design Build Contracts.

1.7.3.2 Weekly Safety Meetings

Conduct weekly safety meetings at the project site for all employees. The Contracting Officer will be informed of the meeting in advance and be allowed attendance. Minutes showing contract title, signatures of attendees and a list of topics discussed shall be attached to the Contractors' daily report.

1.7.3.3 Work Phase Meetings

The appropriate AHA shall be reviewed and attendance documented by the Contractor at the preparatory, initial, and follow-up phases of quality control inspection. The analysis should be used during daily inspections to ensure the implementation and effectiveness of safety and health controls.

1.8 TRAINING

1.8.1 New Employee Indoctrination

New employees (prime and sub-contractor) will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

1.8.2 Periodic Training

Provide Safety and Health Training in accordance with USACE EM 385-1-1 and the accepted APP. Ensure all required training has been accomplished for all onsite employees.

1.8.3 Training on Activity Hazard Analysis (AHA)

Prior to beginning a new phase, training will be provided to all affected employees to include a review of the AHA to be implemented.

1.9 ACCIDENT PREVENTION PLAN (APP)

The Contractor shall use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Preparation of Accident Prevention Plan". Where a paragraph or subparagraph element is not applicable to the work to be performed indicate "Not Applicable" next to the heading. Specific requirements for some of the APP elements are described below at paragraph 1.8.1. The APP shall be job-specific and shall address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Any portions of the Contractor's overall safety and health program referenced in the APP shall be included in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer and any designated CSP and/or CIH.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. The Contracting Officer reviews and comments on the Contractor's submitted APP and accepts it when it meets the requirements of the contract provisions.

Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any unforeseen hazard become evident during the performance of work, the project superintendent shall inform the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, all necessary action shall be taken by the Contractor to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment.

Copies of the accepted plan will be maintained at the resident engineer's office and at the job site. The APP shall be continuously reviewed and amended, as necessary, throughout the life of the contract. Unusual or high-hazard activities not identified in the original APP shall be incorporated in the plan as they are discovered.

1.9.1 EM 385-1-1 Contents

In addition to the requirements outlines in Appendix A of USACE EM 385-1-1, the following is required:

a. Names and qualifications (resumes including education, training, experience and certifications) of all site safety and health personnel designated to perform work on this project to include the designated site safety and health officer and other competent and qualified personnel to be used such as CSPs, CIHs, STSs, CHSTs. The duties of each position shall be specified.

b. Qualifications of competent and of qualified persons. As a minimum, competent persons shall be designated and qualifications submitted for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; personal protective equipment and clothing to include selection, use and maintenance.

c. Confined Space Entry Plan. Develop a confined space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

d. Health Hazard Control Program. The Contractor shall designate a competent and qualified person to establish and oversee a Health Hazard Control Program in accordance with USACE EM 385-1-1, Section 6. The program shall ensure that employees, on-site Government representatives, and others, are not adversely exposed to chemical, physical and biological agents and that necessary controls and protective actions are instituted to ensure health.

e. Crane Critical Lift Plan. Prepare and sign weight handling critical lift plans for lifts over 75 percent of capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted movile crane's hoists) at any radius of lift; lifts involving more thatn one crane or hoist; lifts of personnel; and lifts involving more than rigging or operation, sensitive equipment, or unusual safety risks. The plan shall be submitted 15 calendar day6s prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.c.18. and the following:

(1) For lifts of personnel, the plan shall demonstrate compliance with the requirements of 29 CFR 1926.500(g).

(2) For barge mounted mobile cranes, barge stability calculations identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. Teh amount of list and trim shall be within the crane manufacturer's requirements.

f. Alcohol and Drug Abuse Plan

(1) Describe plan for random checks and testing with pre-employment screening in accordance with the DFAR Clause subpart 252.223-7004, "Drug Free Work Force."

(2) Description of the on-site prevention program

g. Fall Protection and Prevention (FP&P) Plan. The plan shall be site specific and address all fall hazards in the work place and during different phases of construction. It shall address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 1.8 m (6 feet). A qualified person for fall protection shall prepare and sign the plan. The plan shall include fall protection and prevention systems, equipment and methods employed for every phase of work, responsibilities, assisted rescue self-rescue and evacuation procedures, training requirements, and monitoring methods. Fall Protection and Prevention Plan shall be revised every six months for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. The accepted Fall Protection and Prevention Plan shall be kept and maintained at the job site for the duration of the project. The Fall Protection Plan shall be included in the Accident Prevention Plan (APP)

h. Training Records and Requirements. List of mandatory training and certifications which are applicable to this project (e.g. explosive actuated tools, confined space entry, fall protection, crane operation, vehicle operator, forklift operators, personal protective equipment); list of requiremetns for periodic retraining/certification; outline requirements for supervisory and employee safety meetings.

i. Occupant Protection Plan. The safety and health aspects of lead-based paint removal, prepared in accordance with Section 02 83 19.00 10 Lead Based Paint Hazard Abatement, Target Housing & Child Occupied Facilities, 02 82 33.13 20 Removal/Control and Disposal of Lead Containig Paint.

j. Lead Compliance Plan. The safety and health aspects of lead work, prepared in accordance with Section 02 83 13.00 20 Lead in Construction.

k. Asbestos Hazard Abatement Plan. The safety and health aspects of asbestos work, prepared in accordance with Section 02 2 16.00, "Engineering Control of Asbestos Containing Materials"

l. Site Safety and Health Plan. The safety and health aspects prepared in accordance with this section.

m. PCB Plan. The safety and health aspects of Polychlorinated Biphenyls work, prepared in accordance with Sections 02 84 33, "Removal and Disposal of Polychlorinated Biphenyls (PCBs) and 02 61 23, "Removal and Disposal of PCB Contaminated Soils)".

n. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00.00 40, Demolition" and referenced sources. Include engineering survey as applicable.

o. Excavation Plan. The safety and health aspects prepared in accordance with Section 3100, Earthwork.

p. Crane Work Plan. The contractor shall provide a crane work plan to the Contracting Officer for acceptance. The crane work plan shall include the specific model of each crane and a drawing identifying their locations (exact), the dimensions, wheel sizes, number of wheels, wheel spacing, tire pressure(s), number of axles, axle spacing, minimum wheel load to be exerted during operatins and maximum outrigger load to

be exerted during operations. The Contractor shall allow at least 10 working days for acceptance/non-acceptance of the crane work plan. No crane operations shall begin prior to written acceptance of the crane plan by the Government. ROICC shall be the government approving authority.

1.10 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1. Submit the AHA for review at least 15 calendar days prior to the start of each phase. Format subsequent AHA as amendments to the APP. An AHA will be developed by the Contractor for every operation involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or subcontractor is to perform work. The analysis must identify and evaluate hazards and outline the proposed methods and techniques for the safe completion of each phase of work. At a minimum, define activity being performed, sequence of work, specific safety and health hazards anticipated, control measures (to include personal protective equipment) to eliminate or reduce each hazard to acceptable levels, equipment to be used, inspection requirements, training requirements for all involved, and the competent person in charge of that phase of work. For work with fall hazards, including fall hazards associated with scaffold erection and removal, identify the appropriate fall protection methods used. For work with materials handling equipment, address safeguarding measures related to materials handling equipment. For work requiring excavations, include requirements for safeguarding excavations. An activity requiring an AHA shall not proceed until the AHA has been accepted by the Contracting Officer's representative and a meeting has been conducted by the Contractor to discuss its contents with everyone engaged in the activity, including on-site Government representatives. The Contractor shall document meeting attendance at the preparatory, initial, and follow-up phases of quality control inspection. The AHA shall be continuously reviewed and, when appropriate, modified to address changing site conditions or operations. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Activity hazard analyses shall be updated as necessary to provide an effective response to changing work conditions and activities. The on-site superintendent, site safety and health officer and competent persons used to develop the AHAs, including updates, shall sign and date the AHAs before they are implemented.

The activity hazard analyses shall be developed using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided t othe prime contractor for submittal to the Contracting Offficer.

1.11 DISPLAY OF SAFETY INFORMATION

Within 1 calendar days after commencement of work, erect a safety bulletin board at the job site. The following information shall be displayed on the safety bulletin board in clear view of the on-site construction personnel, maintained current, and protected against the elements and unauthorized

removal:

a. Map denoting the route to the nearest emergency care facility.

b. Emergency phone numbers.

c. Copy of the most up-to-date APP.

d. Current AHA(s).

e. OSHA 300A Form.

f. OSHA Safety and Health Protection-On-The-Job Poster.

g. Confined space entry permit.

h. Hot work permit.

i. A sign indicating the number of hours worked since last lost workday accident.

j. Safety and Health Warning Posters.

1.12 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.13 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.14 REPORTS

1.14.1 Accident Reports

a. For recordable injuries and illnesses, and property damage accidents resulting in at least $2,000 in damages, the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the Navy Contractor Significant Incident Report (CSIR) form or USACE Accident Report Form 3394 and provide the report to the Contracting Officer within 1 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

b. For a weight handling equipment accident (including rigging gear accidents) the Prime Contractor shall conduct an accident investigation to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Crane operations shall not proceed until cause is determined and corrective actions have been implemented to the satisfaction of the Contracting Officer. The Contracting Officer will provide a blank copy of the accident report form.

1.14.2 Accident Notification

Notify the Contracting Officer as soon as practical, but not later than four hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident. Information shall include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on site and Government investigation is conducted.

1.14.3 Monthly Exposure Reports

Monthly exposure reporting to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. The Contracting Officer will provide copies of any special forms.

1.14.4 Regulatory Citations and Violations

Contact the Contracting Officer immediately of any OSHA or other regulatory agency inspection or visit, and provide the Contracting Officer with a copy of each citation, report, and contractor response. Correct violations and citations promptly and provide written corrective actions to the Contracting Officer.

1.14.5 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix H and as specified herein with Daily Reports of Inspections.

1.14.6 Certificate of Compliance

The Contractor shall provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate). Certificate shall state that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance shall comply with 29 CFR 1926 and USACE EM 385-1-1 section 16 and Appendix H. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. For cranes at DOD activities in foreign countries, the Contractor shall certify that the crane and rigging gear conform to the appropriate host country safety standards. The Contractor shall also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). These certifications shall be posted on the crane.

1.14.7 Third Party Certification of Barge-Mounted Mobile Cranes

Barge-mounted mobile cranes shall be certified in accordance with 29 CFR 1919 by an OSHA accredited person.

1.15 HOT WORK

Prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, a written permit shall be requested from the Fire Division. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

a. Oil painting materials (paint, brushes, empty paint cans, etc.), and all flammable liquids shall be removed from the facility at quitting time. All painting materials and flammable liquids shall be stored outside in a suitable metal locker or box and will require re-submittal with non-hazardous materials.

b. Accumulation of trays, paper, shavings, sawdust, boxes and other packing materials shall be removed from the facility at the close of each workday and such material disposed of in the proper containers located away from the facility.

c. The storage of combustible supplies shall be a safe distance from structures.

d. Area outside the facility undergoing work shall be cleaned of trash, paper, or other discarded combustibles at the close of each workday.

e. All portable electric devices (saws, sanders, compressors, extension chord, lights, etc.) shall be disconnected at the close of each workday. When possible, the main electric switch in the facility shall be deactivated.

f. When starting work in the facility, Contractors shall require their personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency phone number 911. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED IMMEDIATELY.

g. Obtain services from th FIRE DIVISION for "HOT WORK" within or around flammable materials (such as fuel systems, welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, vaults, etc.) that have the potential for flammable or explosive atmospheres.

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE

The Contractor shall provide permanent signs integral to or securely attached to access covers for all required confined spaces. Signs wording: "DANGER--PERMIT-REQUIRED CONFINED SPACE - DO NOT ENTER -" in bold letters a minimum of 25 mm(one inch) in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" shall be red and readable from 1.52 m(5 feet).

2.2 FALL PROTECTION ANCHORAGE

Fall protection anchorage, conforming to ANSI Z359.1, installed under the supervision of a qualified person in fall protection, shall be left in place for continued customer use and so identified by signage stating the capacity of the anchorage (strength and number of persons who may be tied-off to it at any one time).

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

The Contractor shall comply with USACE EM 385-1-1, NFPA 241, the APP, the AHA, Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard shall prevail.

3.1.1 Hazardous Material Use

Each hazardous material must receive approval prior to being brought onto the job site or prior to any other use in connection with this contract. Allow a minimum of 10 working days for processing of the request for use of a hazardous material. Any work or storage involving hazardous chemicals or materials must be done in a manner that will not expose Government or Contractor employees to any unsafe or unhealthful conditions. Adequate protective measures must be taken to prevent Government or Contractor employees from being exposed to any hazardous condition that could result from the work or storage. The Prime Contractor shall keep a complete inventory of hazardous materials brought onto the work-site. Approval by the Contracting Officer of protective measures and storage area is required prior to the start of the work.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

3.1.3 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos. If additional material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least 15 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, the Contractor shall attend a pre-outage coordination meeting with the Contracting Officer to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 FALL HAZARD PROTECTION AND PREVENTION

The Contractor shall establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. The program shall include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and escape procedures.

3.3.1 Training

The Contractor shall institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, the Contractor shall provide training for each employee who might be exposed to fall hazards. A competent person for fall protection shall provide the training. Training requirements shall be in accordance with USACE EM 385-1-1, section 21.A.16.

3.3.2 Fall Protection Equipment

The Contractor shall enforce use of the fall protection equipment designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is on a surface 1.8 m(6 feet) or more above lower levels. Fall protection systems such as guardrails, personnel fall arrest system, safety nets, etc., are required when working within 1.8m (6 feet) of any leading edge. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, paragraphs 05.I. and 05.J. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems may be required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M and USACE EM 385-1-1.

3.3.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ANSI Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for

attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 1.8 m (6 feet). The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.3.3 Fall Protection for Roofing Work

Fall protection controls shall be implemented based on the type of roof being constructed and work being performed. The roof area to be accessed shall be evaluated for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 1.8 m (6 feet) of an edge, on low-slope roofs, personnel shall be protected from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and is not authorized.

(2) For work greater than 1.8 m (6 feet) from an edge, warning lines shall be erected and installed in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.

b. Steep Roofs: Work on steep roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.3.4 Safety Nets

If safety nets are used as the selected fall protection system on the project, they shall be provided at unguarded workplaces, leading edge work or when working over water, machinery, dangerous operations and or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, fall arrest systems or restraint/positioning systems are impractical. Safety nets shall be tested immediately after installation with a drop test of 181.4 kg (400 pounds) dropped from the same elevation a person might fall, and every six months thereafter.

3.3.5 Existing Anchorage

Existing anchorages, to be used for attachment of personal fall arrest equipment, shall be certified (or re-certified) by a qualified person for fall protection in accordance with ANSI Z359.1. Exiting horizontal lifeline achorages shall be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.3.6 Horizontal Lifelines

Horizontal lifelines shall be designed, installed, certified and used under the supervision of a qualified person for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.3.7 Guardrail Systems

Guardrails shall consist of top and mid-rails, post and toe boards. The top edge height of standard railing must be 42 inches plus or minus 3 inches above the walking/working level. When mid-rails are used, they must be installed at a height midway between the top edge of the guardrail system and the walking/working level. Posts shall be placed no more than 8 feet apart (29 CFR 1926.500 and USACE EM 385-1-1).

3.3.8 Rescue and Evacuation Procedures

When personal fall arrest systems are used, the contracator must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. A Rescue and Evacuation Plan shall be prepared by the contractor and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. The Rescue and Evaluation Plan shall be included in the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.4 PERSONAL PROTECTIVE EQUIPMENT

All personnel who enter a construction site area shall wear Personal Protective Equipment (PPE) at all times as outlined in the EM 385 1-1. In addition to the requirements of the EM 385 1-1, Safety Glasses (ANSI Z87.1) and High-Visibility Apparel (ANSI 107-2004 Performance Class II, Shirt or Vest) will be worn at all times on construction sites. Hearing protection is required in noise hazard areas or when performing noise hazard tasks. Mandatory PPE on all construction sites includes:

a. Hard Hats

b. Safety Glasses

c. High-Visibility Shirt or Vest

d. Safety-Toed Shoes or Boots

3.5 SCAFFOLDING

Employees shall be provided with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Access to scaffold platforms greater than 6 m (20 feet) in height shall be accessed by use of a scaffold stair system. Vertical ladders commonly provided by scaffold system manufacturers shall not be used for accessing scaffold platforms greater than 6 m (20 feet) in height. The use of an adequate gate is required. Contractor shall ensure that employees are qualified to perform scaffold erection and dismantling. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Special care shall be given to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of

the scaffold base. Work platforms shall be placed on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.5.1 Stilts

The use of stilts for gaining additional height in construction, renovation, repair or maintenance work is prohibited.

3.6 EQUIPMENT

3.6.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.6.2 Weight Handling Equipment

a. Cranes must be equipped with:

(1) Load indicating devices (LIDs) and a boom angle or radius indicator,

(2) or load moment indicating devices (LMIs).

(3) Anti-two block prevention devices.

(4) Boom hoist hydraulic relief valve, disconnect, or shutoff (stops hoist when boom reaches a predetermined high angle).

(5) Boom length indicator (for telescoping booms).

(6) Device to prevent uncontrolled lowering of a telescoping hydraulic boom.

(7) Device to prevent uncontrolled retraction of a telescoping hydraulic boom.

b. The Contractor shall notify the Contracting Officer 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Contractor's operator shall remain with the crane during the spot check.

c. The Contractor shall comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Erection shall be performed under the supervision of a designated person (as defined in ASME B30.5). All testing shall be performed in accordance with the manufacturer's

recommended procedures.

d. The Contractor shall comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

e. The presence of Government personnel does not relieve the Contractor of an obligation to comply with all applicable safety regulations. The Government will investigate all complaints of unsafe or unhealthful working conditions received in writing from contractor employees, federal civilian employees, or military personnel.

f. Each load shall be rigged/attached independently to the hook/master-link in such a fashion that the load cannot slide or otherwise become detached. Christmas-tree lifting (multiple rigged materials) is not allowed.

g. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.

h. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and shall follow the requirements of USACE EM 385-1-1 section 11 and ASME B30.5 or ASME B30.22 as applicable.

i. Crane suspended personnel work platforms (baskets) shall not be used unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Personnel shall not be lifted with a line hoist or friction crane.

j. A fire extinguisher having a minimum rating of 10BC and a minimum nominal capacity of 5lb of extinguishing agent shall be available at all operator stations or crane cabs. Portable fire extinguishers shall be inspected, maintained, and recharged as specified in NFPA 10, Standard for Portable Fire Extinguishers.

k. All employees shall be kept clear of loads about to be lifted and of suspended loads.

l. A weight handling equipment operator shall not leave his position at the controls while a load is suspended.

m. The Contractor shall use cribbing when performing lifts on outriggers.

n. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

o. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

p. A substantial and durable rating chart containing legible letters and figures shall be provided with each crane and securely mounted onto the crane cab in a location allowing easy reading by the operator while seated in the control station.

q. Certification records which include the date of inspection,

signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

r. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

s. The Contractor shall certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

3.6.3 Equipment and Mechanized Equipment

a. Equipment shall be operated by designated qualified operators. Proof of qualifications shall be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment shall be on site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Such additional safety precautions or requirements shall be incorporated into the AHAs.

c. Equipment and mechanized equipment shall be inspected in accordance with manufacturer's recommendations for safe operation by a competent person prior to being placed into use.

d. Daily checks or tests shall be conducted and documented on equipment and mechanized equipment by designated competent persons.

3.7 EXCAVATIONS

The competent person for excavations performed as a result of contract work shall be on-site when excavation work is being performed, and shall inspect, and document the excavations daily prior to entry by workers. The competent person must evaluate all hazards, including atmospheric, that may be associated with the work, and shall have the resources necessary to correct hazards promptly. The competent person shall perform soil classification in accordance with 29 CFR 1926.

3.7.1 Utility Locations

All underground utilities in the work area must be positively identified by a third party, independent, private utility locating company in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract.

3.7.2 Utility Location Verification

The Contractor must physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility the utility shall be exposed by hand digging every 100 feet if parallel within 5 feet of the excavation.

3.7.3 Utilities Within and Under Concrete, Bituminous Asphalt and Other Impervious Surfaces

Utilities located within concrete slabs or pier decks, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company shall locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.7.4 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on site for review. Job-made shoring or shielding shall have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

3.7.5 Trenching Machinery

Trenching machines with digging chain drives shall be operated only when the spotters/laborers are in plain view of the operator. Operator and spotters/laborers shall be provided training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Documentation of the training shall be kept on file at the project site.

3.8 ELECTRICAL

3.8.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts,

coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may be required, depending on the specific job and as delineated in the Contractor's AHA.

3.8.2 Arc Flash Risk/Hazard Analysis

Contractor shall provide an Arc Flash Risk/Hazsrd Analysis in accordance with NFPA 70E for all locations where workers may be exposed to arc flash hazard (work on energized electrical equipment). The Arc Flash Risk/Hazard Analysis shall be sealed and signed by a qualified professional engineer.

3.8.3 Arc Flash Risk/Hazard Analysis Qualifications

Contractor shall engage the services of a qualified organization to provide Arc Flash Risk/Hazard Analysis of the electrial distribution system. Organization shall be independent of th aupplier, manufacturer, and installer of ht equipment. The organization shall be a first tier subcontractor. This work shall not be performed by a second tier subcontractor.

a. Submit name and qualificaitons of organization. Organization shall have been regularaly engaged in providing Arc Flash Risk/Hazard Analysis for a minimum of 5 years.

b. Submit name and qualifications of the professional engineer performing the analysis. Include a list of three comparable jobs performed by the engineer with specific names nad telephone numbers for reference.

3.8.4 Special Permission Energized Electrical Work Permit

All work on energized electrical systems, including high voltage, must have an approved "Special Permission Energized Electrical Work Permit." The results of a Arc Flash Risk/Hazard Analysis, per NFPA 70E, shall be included in the "Special Permission Energized Electrical Work Permit" request. Flame-resistant (FR) clothing and personel protective equipment (PPE) shall be rated for a minimum of 8 calories per square centimeter even if the flash hazard analysis indicates a lower value. A blank copy of the permit request is attached. An editable version may be obtained from the Contracting Officer.

3.8.5 Portable Extension Cords

Portable extension cords shall be sized in accordance with manufacturer ratings for the tool to be powered and protected from damage. All damaged extension cords shall be immediately removed from service. Portable extension cords shall meet the requirements of NFPA 70.

3.9 WORK IN CONFINED SPACES

The Contractor shall comply with the requirements in Section 06.I of USACE EM 385-1-1 and OSHA 29 CFR 1910.146. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or

enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 06.I.05 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Ensure the use of rescue and retrieval devices in confined spaces greater than 1.5 m (5 feet) in depth. Conform to Sections 06.I.09, 06.I.10 and 06.I.11 of USACE EM 385-1-1.

d. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

e. Include training information for employees who will be involved as entrants and attendants for the work. Conform to Section 06.I.06 of USACE EM 385-1-1.

f. Daily Entry Permit. Post the permit in a conspicuous place close to the confined space entrance.

3.10 CRYSTALLINE SILICA

Grinding, abrasive blasting, and foundry operations of construction materials containing crystalline silica, shall comply with OSHA regulations, such as 29 CFR 1910.94, and USACE EM 385-1-1, Appendix C. The Contractor shall develop and implement effective exposure control and elimination procedures to include dust control systems, engineering controls, and establishment of work area boundaries, as well as medical surveillance, training, air monitoring, and personal protective equipment.

3.11 HOUSEKEEPING

3.11.1 Clean-Up

All debris in work areas shall be cleaned up daily or more frequently if necessary. Construction debris may be temporarily located in an approved location, however garbage accumulation must be removed each day.

3.11.2 Falling Object Protection

All areas must be barricaded to safeguard employees. When working overhead, barricade the area below to prevent entry by unauthorized employees. Construction warning tape and signs shall be posted so they are clearly visible from all possible access points. When employees are working overhead all tools and equipment shall be secured so that they will not fall. When using guardrail as falling object protection, all openings shall be small enough to prevent passage of potential falling objects.

-- End of Section --

Special Permission Energized Electrical Work Permit

Permit Number:

Part I: Request for Special Permission

Job Order/Contract Number:

(1) Description of circuit/equipment:

(2) Job Location:

(3) Description of work to be done:

(4) Justification of why the circuit/equipment cannot be de-energized:

(5) Anticipated Duration of Work Requiring Special Permission: (hours/minutes) _____ On (date) _____

(6) Means Employed to Restrict Access of Unqualified Persons:

(7) Shock Hazard Analysis:

Voltage _____ Approach Boundaries: (distance) Limited _____ Restricted_____ Prohibited_____ Flash_____

(8) Flash Hazard Analysis: Calorie PPE required _____ (8 minimum)

Approach Boundaries to be crossed: (Check as applicable) Limited ____ Restricted_____ Prohibited____ Flash Protection _____

(9) PPE to be used: (in addition to required daily wear)

Leather Gloves:	**Yes____ No____**
Voltage Rated Rubber Gloves with Leather Protectors	**Yes____ No____**
Safety Glasses	**Yes____ No____**
Arc Flash Face Shield rated 10-cal/cm sq or more	**Yes____ No____**
Arc Flash Hood rated 20 cal/cm sq or more	**Yes____ No____**
Safety Helmet	**Yes____ No____**
Balaclava (Head Sock)	**Yes____ No____**
Hearing Protection (single level)	**Yes____ No____**
Voltage Rated Tools	**Yes____ No____**
Hazard Risk Category 3 Clothing	**Yes____ No____**

(10) Source of Lighting: Outside Daylight___ Inside Existing Artificial ___ Temporary Portable Lighting: (AC) ___ Battery___

(11) Name of Employee(s) Assigned to Job and will receive job briefing before beginning work (sign in sheet required):

Requested By_____

Name Typed **Organization (BL / FEAD / PWO)** **Phone #**

_____

Signature

Part II: Recommended Approval

Construction Safety Manager Concurrence: _____ Date: _____

Notification:

Operation Officer:_____Date: _____

Executive Officer:_____Date: _____

Approved by: _____ Date _____

Commanding Officer / Designee

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

01/07

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number. The designations "AOK" and "LOK" are for administrative purposes and should not be used when ordering publications.

ACI INTERNATIONAL (ACI)
P.O. Box 9094
Farmington Hills, MI 48333-9094
Ph: 248-848-3700
Fax: 248-848-3701
Internet: http://www.aci-int.org
AOK 5/01
LOK 2/01

ACOUSTICAL SOCIETY OF AMERICA (ASA)
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
E-mail: asa@aip.org
Internet: http://asa.aip.org

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)
4301 North Fairfax Dr., Suite 425
ATTN: Pubs Dept.
Arlington, VA 22203
Ph: 703-524-8800
Fax: 703-528-3816
E-mail: ari@ari.org
Internet: http://www.ari.org
AOK 5/01
LOK 2/01

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)
30 W. University Dr.
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
Internet: http://www.amca.org
AOK 5/01
LOK 2/01

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)
1200 G Street, NW, Suite 500
Washington, D.C. 20005
Ph: 202-628-6380
Fax: 202-393-5453
Internet: http://www.atis.org

ALUMINUM ASSOCIATION (AA)
900 19th Street N.W.
Washington, DC 20006
Ph: 202-862-5100
Fax: 202-862-5164
Internet: http://www.aluminum.org
AOK 5/01
LOK 2/01

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Ofc. Sq.
Suite 104
Schaumburg, IL 60173-4268
Ph: 847-303-5664
Fax: 847-303-5774
Internet: http://www.aamanet.org
AOK 5/01
LOK 2/01

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 N. Capital St., NW, Suite 249
Washington, DC 20001
Ph: 800-231-3475 202-624-5800
Fax: 800-525-5562 202-624-5806
Internet: http://www.transportation.org
AOK 5/01
LOK 2/01

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
P.O. Box 12215
Research Triangle Park, NC 27709-2215
Ph: 919-549-8141
Fax: 919-549-8933
Internet: http://www.aatcc.org
AOK 5/01
LOK 2/01

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
2025 M Street, NW, Suite 800
Washington, DC 20036
Ph: 202-429-5155
Fax: 202-828-6042

Internet: http://www.abma-dc.org
AOK 5/01
LOK 2/01

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Dr.
Suite 600
Cincinnati, OH 45240
Ph: 513-742-2020
Fax: 513-742-3355
Internet: http://www.acgih.org
E-mail: pubs@acgih.org
AOK 5/01
LOK 2/01

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)
American Wood Council
ATTN: Publications Dept.
1111 Nineteenth St. NW, Suite 800
Washington, DC 20036
Ph: 800-294-2372 or 202-463-2700
Fax: 202-463-2471
Internet: http://www.forestprod.org/awc/
AOK 5/01
LOK 6/00

AMERICAN HARDBOARD ASSOCIATION (AHA)
c/o Composite Panel Association
18922 Premiere Court
Gaithersburg, MD 20879-1574
Ph: 301-670-0604
Fax: 301-840-1252
Internet: http://www.pbmdf.org

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001
Ph: 312-670-2400
Publications: 800-644-2400
Fax: 312-670-5403
Internet: http://www.aisc.org
AOK 5/01
LOK 3/01

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)
7012 So. Revere Parkway, Suite 140
Englewood, CO 80112
Ph: 303-792-9559
Fax: 303-792-0669
Internet: http://www.aitc-glulam.org
AOK 5/01
LOK 3/01

AMERICAN IRON AND STEEL INSTITUTE (AISI)
1101 17th St., NW Suite 1300
Washington, DC 20036
Ph: 202-452-7100
Internet: http://www.steel.org
AOK 5/01

LOK 3/01

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)
P.O. Box 210
Germantown, MD 20875-0210
Ph: 301-972-1700
Fax: 301-540-8004
E-mail: alsc@alsc.org
Internet: http://www.alsc.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1819 L Street, NW, 6th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
Internet: http://www.ansi.org/

Note --- Documents beginning with the letter "S" can be ordered from:

Acoustical Society of America
Standards and Publications Fulfillment Center
P. O. Box 1020
Sewickley, PA 15143-9998
Ph: 412-741-1979
Fax: 412-741-0609
Internet: http://asa.aip.org
General e-mail: asa@aip.org
Publications e-mail: asapubs@abdintl.com
AOK 5/01
LOK 6/00

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)
8201 Corporate Dr., Suite 1125
Landover, MD 20785-2230
Ph: 301-459-3200
Fax: 301-459-8077
Internet: http://www.arema.org
AOK 5/01
LOK 3/01

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
1711 Arlingate Lane
P.O. Box 28518
Columbus, OH 43228-0518
Ph: 800-222-2768
Fax: 614-274-6899
Internet: http://www.asnt.org
AOK 5/01
LOK 6/00

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Ph: 610-832-9585
Fax: 610-832-9555
Internet: http://www.astm.org
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AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191-4400
Ph: 703-295-6300 - 800-548-2723
Fax: 703-295-6222
Internet: http://www.asce.org
e-mail: marketing@asce.org
AOK 5/01
LOK 3/01

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
Ph: 800-527-4723 or 404-636-8400
Fax: 404-321-5478
Internet: http://www.ashrae.org
AOK 5/01
LOK 3/01

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
901 Canterbury, Suite A
Westlake, OH 44145
Ph: 440-835-3040
Fax: 440-835-3488
E-mail: asse@ix.netcom.com
Internet: http://www.asse-plumbing.org
AOK 5/01
LOK 3/01

AMERICAN WATER WORKS ASSOCIATION(AWWA)
6666 West Quincy
Denver, CO 80235
Ph: 800-926-7337 - 303-794-7711
Fax: 303-794-7310
Internet: http://www.awwa.org
AOK 5/01
LOK 3/01

AMERICAN WELDING SOCIETY (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
Internet: http://www.amweld.org
AOK 5/01
LOK 3/01

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)
P.O. Box 5690
Grandbury, TX 76049-0690
Ph: 817-326-6300
Fax: 817-326-6306
Internet: http://www.awpa.com
AOK 5/01
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APA - THE ENGINEERED WOOD ASSOCIATION (APA)
P.O.Box 11700
Tacoma, WA 98411-0700
Ph: 253-565-6600
Fax: 253-565-7265
Internet: http://www.apawood.org
AOK 5/01
LOK 6/00

ARCHITECTURAL WOODWORK INSTITUTE (AWI)
1952 Isaac Newton Square West
Reston, VA 20190
Ph: 703-733-0600
Fax: 703-733-0584
Internet: http://www.awinet.org
AOK 5/01
LOK 6/00

ASME INTERNATIONAL (ASME)
Three Park Avenue
New York, NY 10016-5990
Ph: 212-591-7722
Fax: 212-591-7674
Internet: http://www.asme.org
AOK 5/01
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ASPHALT ROOFING MANUFACTURER'S ASSOCIATION (ARMA)
1156-15TH Street, NW, Suite 900
Washington D.C. 20005
Ph: 202-207-0917
Fax: 202-223-9741
Internet: http://www.asphaltroofing.org

ASSOCIATED AIR BALANCE COUNCIL (AABC)
1518 K St., NW, Suite 503
Washington, DC 20005
Ph: 202-737-0202
Fax: 202-638-4833
Internet: http://www.aabchq.com
E-mail: aabchq@aol.com
AOK 5/01
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ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 No. 18th St.
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-2530
Fax: 205-257-2540
Internet: http://www.aeic.org
AOK 5/01
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ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)
1111 19th St. NW., Suite 402
Washington, DC 20036
Ph: 202-872-5955
Fax: 202-872-9354

Internet: http://www.aham.org
AOK 5/01
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BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
355 Lexington Ave.
17th floor
New York, NY 10017-6603
Ph: 212-297-2122
Fax: 212-370-9047
Internet: http://www.buildershardware.com
AOK 5/01
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CARPET AND RUG INSTITUTE (CRI)
310 Holiday Ave.
Dalton, GA 30720
P.O. Box 2048
Dalton, GA 30722-2048
Ph: 706-278-0232
Fax: 706-278-8835
Internet: http://www.carpet-rug.com
AOK 5/01
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CAST IRON SOIL PIPE INSTITUTE (CISPI)
5959 Shallowford Rd., Suite 419
Chattanooga, TN 37421
Ph: 423-892-0137
Fax: 423-892-0817
Internet: http://www.cispi.org
AOK 5/01
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COMPOSITE PANEL ASSOCIATION (CPA)
18922 Premeire Court
Gaithersburg, MD 20879-1574
Ph: 301-670-0604
Fax: 301-840-1252
Internet: http://www.pbmdf.com

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
933 N. Plum Grove Rd.
Schaumburg, IL 60173-4758
Ph: 847-517-1200
Fax: 847-517-1206
Internet: http://www.crsi.org/
AOK 5/01
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COPPER DEVELOPMENT ASSOCIATION (CDA)
260 Madison Ave.
New York, NY 10016
Ph: 212-251-7200
Fax: 212-251-7234
Internet: http://www.copper.org
E-mail: staff@cda.copper.org
AOK 5/01
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CSA AMERICA INC (CSA/AM)
8501 East Pleasant Valley Road
Cleveland, OH 44131-5575
Ph: 216-524-4990
Fax: 216-520-8979
E-mail: cathy.rake@csa-america.org
Internet: http://www.csa-america.org

DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)
1300 Sumner Avenue
Cleveland, OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105
Internet: http://www.dasma.com
e-mail: dasma@dasma.com
AOK 5/01
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EIFS INDUSTRY MEMBERS ASSOCIATION (EIMA)
3000 Corporate Center Drive, Suite 270
Morrow, GA 30260
Ph: 800-294-3462
Fax: 770-968-5818
Internet: http://www.eifsfacts.com
AOK 11/01
LOK 6/00

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)
1650 South Dixie Highway, Ste. 500
Boca Raton, FL 33432
Ph: 561-750-5575
Fax: 561-395-8557
Internet: http://www.egsa.org
AOK 5/01
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ELECTRONIC INDUSTRIES ALLIANCE (EIA)
2500 Wilson Blvd.
Arlington, VA 22201-3834
Ph: 703-907-7500
Fax: 703-907-7501
Internet: http://www.eia.org
AOK 5/01
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FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)
500 River Ridge Drive
Norwood, MA 02062
Ph: 781-255-6681
Ph: (Toll-Free): 877-364-6726
Fax: 781-255-0181
Internet: http://www.fmglobal.com
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FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)
University of South California

Kaprielian Hall 200
Los Angeles, CA 90089-2531
Ph: 213-740-2032
Fax: 213-740-8399
Internet: http://www.usc.edu/dept/fccchr
AOK 5/01
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GLASS ASSOCIATION OF NORTH AMERICA (GANA)
2945 SW Wanamaker Drive, Suite A
Topeka, KS 66614-5321
Ph: 785-271-0208
Fax: 785-271-0166
Internet: http://www.glasswebsite.com/GANA
AOK 5/01
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GREEN SEAL (GS)
1001 Connecticut Avenue, NW
Suite 827
Washington, DC 20036-5525
Ph: 202-872-6400
Fax: 202-872-4324
E-mail: greenseal@greenseal.org
Internet: http://www.greenseal.org

GYPSUM ASSOCIATION (GA)
810 First St. NE, Suite 510
Washington, DC 20002
Ph: 202-289-5440
Fax: 202-289-3707
Internet: http://www.gypsum.org
AOK 5/01
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HARDWOOD PLYWOOD & VENEER ASSOCIATION (HPVA)
1825 Michael Faraday Dr.
P.O. Box 2789
Reston, VA 20195-0789
Ph: 703-435-2900
Fax: 703-435-2537
Internet: http://www.hpva.org
AOK 5/01
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H.P. WHITE LABORATORY (HPW)
3114 Scarboro Rd.
Street, MD 21154
Ph: 410-838-6550
fax: 410-838-2802
Internet: http://www.hpwhite.com
AOK 5/01
LOK 6/00

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)
120 Wall St., 17th Floor
New York, NY 10005-4001
Ph: 212-248-5000
Fax: 212-248-5017

Internet: http://www.iesna.org
AOK 5/01
LOK 6/00

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)
703 Waterford Way (NW 62nd Avenue), Suite 600
Miami, FL 33126
Ph: 305-264-7772
Fax: 305-264-8088
Internet: http://www.iata.org

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 Hoes Ln, P. O. Box 1331
Piscataway, NJ 08855-1331
Ph: 732-981-0060 OR 800-701-4333
Fax: 732-981-9667
Internet: http://www.ieee.org
E-mail: customer.services@ieee.org
AOK 5/01
LOK 6/00

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 440
South Yarmouth, MA 02664
Ph: 508-394-4424
Fax: 508-394-1194
E-mail:
Internet: http://www.icea.net
AOK 5/01
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INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)
20001 Walnut Dr., So.
Walnut, CA 91789-2825
Ph: 909-595-8449
Fax: 909-594-3690
Fax for Stds: 909-594-5265
Internet: http://www.iapmo.org
AOK 5/01
LOK 6/00

INTERNATIONAL CODE COUNCIL (ICC)
5203 Leesburg Pike, Suite 600
Falls Church, VA 22041
Ph: 703-931-4533
Fax: 703-379-1546
Internet: http://www.intlcode.org
AOK 5/01
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INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)
5360 Workman Mill Rd.
Whittier, CA 90601-2298
Ph: 800-284-4406
Ph: 562-699-0541
Fax: 562-692-3853
Internet: http://www.icbo.org
AOK 5/01

LOK 6/00

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
P.O. Box 687
106 Stone Street
Morrison, Colorado 80465
PH: 303-697-8441
FAX: 303-697-8431
Internet: http://www.netaworld.org
AOK 6/01

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
3, rue de Varembe, P.O. Box 131
CH-1211 Geneva 20, Switzerland
Ph: 41-22-919-0211
Fax: 41-22-919-0300
Internet: http://www.iec.ch
e-mail: info@iec.ch
AOK 5/01
LOK 6/00

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
1, rue de Varembe'
Case Postale 56
CH-1211 Geneve 20
Ph: 41-22-749-0111
Fax: 41-22-733-3430
Internet: http://www.iso.ch
e-mail: central@iso.ch
AOK 5/01
LOK 6/00

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)
1901 North Moore Street
Arlington, VA 2ee09-1762
Ph: 703-525-1695
Fax: 703-528-2148
E-mail: isea@safety equipment.org
Internet: http://www.safetyequipment.org/

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)
1899 Preston White Dr.
Reston, VA 20191-5435
Ph: 703-264-1690
Fax: 703-620-6530
Internet: http://www.kcma.org
AOK 5/01
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
127 Park St., NE
Vienna, VA 22180-4602
Ph: 703-281-6613
Fax: 703-281-6671
Internet: http://www.mss-hq.com
e-mail: info@mss-hq.com
AOK 5/01
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MAPLE FLOORING MANUFACTURERS ASSOCIATION (MFMA)
60 Revere Dr., Suite 500
Northbrook, IL 60062
Ph: 847-480-9138
Fax: 847-480-9282
Internet: http://www.maplefloor.org
AOK 5/01
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MARBLE INSTITUTE OF AMERICA (MIA)
30 Eden Alley, Suite 301
Columbus, OH 43215
Ph: 614-228-6194
Fax: 614-461-1497
Internet: http://www.marble-institute.com
e-mail: stoneassociations@hotmail.com
AOK 5/01
LOK 6/00

MASTER PAINTERS INSTITUTE (MPI)
4090 Graveley Street
Burnaby, BC CANADA V5C 3T6
PH: 888-674-8937
Fx: 888-211-8708
Internet: http://www.paintinfo.com/mpi
AOK 9/01
LOK 0/00

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)
1300 Sumner Ave.
Cleveland, OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105
Internet: http://www.mbma.com
e-mail: mbma@mbma.com
AOK 5/01
LOK 6/00

MIDWEST ROOFING CONTRACTORS ASSOCIATION (MRCA)
4840 Bob Billings Parkway, Suite 1000
Lawrence, Kansas 66094-3862
Ph: 785-843-4888 or 800-497-6722
Fax: 785-843-7555
E-mail: mrca@mrca.org
Interent: General Information: http://www.mrca.org

NACE INTERNATIONAL (NACE)
1440 South Creek Drive
Houston, TX 77084-4906
Ph: 281-228-6200
Fax: 281-228-6300
Internet: http://www.nace.org
AOK 5/01
LOK 6/00

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)
8 S. Michigan Ave, Suite 1000
Chicago, IL 60603

Ph: 312-782-4951
Fax: 312-332-0405
Internet: http://www.naamm.org
e-mail: naamm@gss.net
AOK 5/01
LOK 6/00

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 N. 17th St., Suite 1847
Rosslyn, VA 22209
Ph: 703-841-3200
Fax: 703-841-3300
Internet: http://www.nema.org/
AOK 5/01
LOK 6/00

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)
8575 Grovemont Circle
Gaithersburg, MD 20877-4121
Ph: 301-977-3698
Fax: 301-977-9589
Internet: http://www.nebb.org
AOK 5/01
LOK 6/00

NATIONAL FENESTRATION RATING COUNCIL (NFRC)
1300 Spring Street, Suite 500
Silver Spring, MD 20910
Ph: 301-589-6372
Fax: 303-588-6342
Internet: http://www.nfrc.org
E-Mail: nfrcusa@aol.com or info@nfrc.com
AOK 5/01
LOK 6/00

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
Ph: 617-770-3000
Fax: 617-770-0700
Internet: http://www.nfpa.org
AOK 5/01
LOK 8/00

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)
P.O. Box 34518
Memphis, TN 38184-0518
Ph: 901-377-1818
Fax: 901-382-6419
e-mail: info@natlhardwood.org
Internet: http://www.natlhardwood.org
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NATIONAL INSTITUTE OF JUSTICE (NIJ)
National Law Enforcement and Corrections Technology Center
2277 Research Blvd. - Mailstop 1E
Rockville, MD 20850

Ph: 800-248-2742 or 301-519-5060
Fax: 301-519-5149
Internet: http://www.nlectc.org
e-mail: asknlectc@nlectc.org
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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
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Gaithersburg, MD 20899-3460
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or
National Technical Information Services (NTIS)
5285 Port Royal Rd.
Springfield, VA 22161
Ph: 703-605-6000
Fax: 703-605-6900
Internet: http://www.ntis.gov
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NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)
10255 W. higgins Rd., Suite 600
Rosemont, IL 60018
Ph: 847-299-9070
Fax: 847-299-1183
Internet: http://www.nrca.net
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NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)
272 Tuttle Road
P.O. Box 87A
Cumberland Center, ME 04021
Ph: 207-829-6901
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Internet: http://www.nsf.org
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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)
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F-75775 Paris Cedex 16
France
Ph: + 33 1 45 24 82 00
Fax: 33 1 45 24 85 00
E-mail: bookshop@oecd.org
Internet: http://www.oecd.org

U.S. Contact Center
OECD Washington Center
2001 L Streeet, NW, Suite 650
Washington, DC 20036-4922
Ph: 202-785-6323
Fax: 202-785-0350
E-mail: washington.contact@oecd.org

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)
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Glen Ellyn, IL 60137
Ph: 630-858-6540
Fax: 630-790-3095
Internet: http://www.ppfahome.org
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Internet: http://www.pdionline.org
E-Mail: info@pdionline.org
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Norcross, GA 30092
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e-mail: penamel@aol.com
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Chicago, IL 60606-6938
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Fax: 415-382-8531
E-Mail: info@calredwood.org
Internet: http://www.calredwood.org

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)
1939 Harrison Street, Suite 400
Oakland, CA 94612
Ph: 510-832-1415
FAX: 510-832-0359
Internet: http://www.scs1.org
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SCIENTIFIC EQUIPMENT AND FURNITURE ASSOCIATION (SEFA)
1205 Franklin Avenue, Suite 320
Garden City, N.Y. 11530
Ph: 516-294-5424
Fax: 516-294-27582

SCREEN MANUFACTURERS ASSOCIATION (SMA)
2850 South Ocean Boulevard, Suite 311
Palm Beach, FL 33480-5535
Ph: 561-533-0991
Fax: 561-533-7466
e-mail: fitzgeraldfscott@aol.com
Internet: http://www.screenmfgassociation.org
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SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)
4201 Lafayette Center Dr.,
Chantilly, VA 20151-1209
Ph: 703-803-2980
Fax: 703-803-3732
Internet: http://www.smacna.org
e-mail: info@smacna.org
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SINGLE PLY ROOFING INSTITUTE (SPRI)
200 Reservoir St., Suite 309A
Needham, MA 02494
Ph: 781-444-0242
Fax: 781-444-6111
Internet: http://www.spri.org
e-mail: spri@spri.org
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NOTE --- Name is now just SPRI.

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)
400 Commonwealth Dr.
Warrendale, PA 15096-0001
Ph: 724-776-4841
Fax: 724-776-5760
Internet: http://www.sae.org
e-mail: custsvc@sae.org
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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
21865 Copley Drive
Diamond Bar, CA 91765-4182
Ph: 909-396-2000
E-mail: webinquiry@aqmd.gov
Internet: http://www.aqmd.gov

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)
400 Penn Center Boulevard, Suite 530
Pittsburgh, PA 15235
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SOUTHERN PINE INSPECTION BUREAU (SPIB)
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Pensacola, FL 32504-9094
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Fax: 850-433-5594
e-mail: spib@spib.org
Internet: http://www.spib.org
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STEEL DECK INSTITUTE (SDI)
P.O. Box 25
Fox River Grove, IL 60021-0025
Ph: 847-462-1930
Fax: 847-462-1940
Internet: http://www.sdi.org
e-mail: Steve@sdi.org
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STEEL DOOR INSTITUTE (SDOI)
30200 Detroit Rd.
Cleveland, OH 44145-1967
Ph: 440-899-0010
Fax: 440-892-1404
Internet: http://www.steeldoor.org
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STEEL JOIST INSTITUTE (SJI)
3127 Tenth Ave., North Ext.
Myrtle Beach, SC 29577-6760
Ph: 843-626-1995

Fax: 843-626-5565
Internet: http://www.steeljoist.org
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TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)
P.O. Box 105113
Atlanta, GA 30348-5113
PH: 800-322-8686
Internet: http://www.tappi.org
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THE INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)
27 ave Goulburn Avenue
Ottawa, Ontario. CANADA
K1N 8C7
Phone: 613-233-1510
Fax: 613-233-1929
e-mail: info@igmaonline.org
Internet: http://www.igmaonline.org
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NOTE --- Correct organization name does not include "The".

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656
Ph: 412-281-2331
Fax: 412-281-9992
Internet: http://www.sspc.org
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TILE COUNCIL OF AMERICA (TCA)
100 Clemson Research Blvd
Anderson, SC 29625
Ph: 864-646-8453
FAX: 864-646-2821
Internet: http://www.tileusa.com
e-mail: literature@tileusa.com
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TRUSS PLATE INSTITUTE (TPI)
583 D'Onofrio Dr., Suite 200
Madison, WI 53719
Ph: 608-833-5900
Fax: 608-833-4360
Internet: None
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TURFGRASS PRODUCERS INTERNATIONAL (TPI)
1855-A Hicks Road
Rolling Meadows, IL 60008
PH: 800-405-8873
FAX: 847-705-8347
Internet: http://www.turfgrasssod.org

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UNDERWRITERS LABORATORIES (UL)
333 Pfingsten Rd.
Northbrook, IL 60062-2096
Ph: 847-272-8800
Fax: 847-272-8129
Internet: http://www.ul.com/
e-mail: northbrook@us.ul.com
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UNI-BELL PVC PIPE ASSOCIATION (UBPPA)
2655 Villa Creek Dr., Suite 155
Dallas, TX 75234
Ph: 214-243-3902
Fax: 214-243-3907
Internet: http://www.uni-bell.org
e-mail: info@uni-bell.org
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Internet: http://www.wes.army.mil/SL/MTC/handbook/handbook.htm

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or http://www.hnd.usace.army.mil/techinfo/index.htm
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U.S. DEFENSE LOGISTICS AGENCY (DLA)
Andrew T. McNamara Building
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Fort Belvoir, VA 22060
Internet: http://www.dla.mil
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Ph: 301-504-9430
Fax: 301-504-8098
Internet: http://www.ams.usda.gov/nop/
e-mail: jeri.irwin@usda.gov

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Fax: 215-697-1462
Internet: http://www.dodssp.daps.mil
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U. S. GREEN BUILDING COUNCIL (USGBC)
1015 18th Street, NW, Suite 508
Washington, D.C. 20036
Ph: 202-828-7422
Fax: 202-828-5110
E-mail: info@usbc.org
Internet: http://www.usgbc.org
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U.S. DEPARTMENT OF STATE (SD)
ATTN: DS/PSP/SEP
SA-6, Room 804
Washington, DC 20522-0602
Ph: 703-875-6537
Internet: http://www.state.gov
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U.S. DEPARTMENT OF TRANSPORTATION (DOT)
400 7th Street, SW
Washington, DC 20590
Internet: http://www.dot.gov
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
Ph: 202-260-2090
FAX: 202-260-6257
Internet: http://www.epa.gov

NOTE --- Some documents are available only from:
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Office of Highway Safety (HHS-31)
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U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)
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Norfolk, VA 23511-2699
Ph: 757-322-4200
Fax: 757-322-4416
Internet: http://www.efdlant.navfac.navy.mil/LANTOPS_15
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U.S. NAVAL FACILITIES ENGINEERING SERVICE CENTER (NFESC)
1100 23rd Avenue
Port Hueneme, CA 93043-4370

Ph: 805-982-4980
Internet: http://www.nfesc.navy.mil
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WEST COAST LUMBER INSPECTION BUREAU (WCLIB)
P.O. Box 23145
Portland, OR 97281
Ph: 503-639-0651
Fax: 503-684-8928
Internet: http://www.wclib.org
e-mail: info@wclib.org
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WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)
Yeon Bldg.
522 SW 5th Ave.
Suite 500
Portland, OR 97204-2122
Ph: 503-224-3930
Fax: 503-224-3934
Internet: http://www.wwpa.org
e-mail: info@wwpa.org
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WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)
1400 East Touhy Ave., Suite 470
Des Plaines, IL 60018
Ph: 847-299-5200 or 800-223-2301
Fax: 708-299-1286
Internet: http://www.wdma.com
e-mail: admin@wdma.com
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WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)
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Fax: 916-661-9586
Internet: http://www.wmmpa.com
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WOOLMARK BUSINESS INTELIGENCE (WBI)
The Woolmark Company
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New York, NY 10020
Ph: 646-756-2535
Fax: 646 756 2538
Internet: www.woolmark.org

-- End of Section --

SECTION 01 45 10

QUALITY CONTROL

09/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 880	(1996) Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 3666	(2000) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 3740	(1999c) Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(2000a) Agencies Engaged in the Testing and Inspection of Materials Used on Construction
ASTM E 543	(1999) Evaluating Agencies that Perform Nondestructive Testing

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-11 Closeout Submittals

Quality Control Plan (QC PLAN)

Submit a QC plan within 15, 30 calendar days after receipt of Notice of Award.

1.3 INFORMATION FOR THE CONTRACTING OFFICER

Deliver the following to the Contracting Officer:

a. Combined Contractor Production Report/Contractor Quality Control Report (1 sheet): Original and 1 copy, by 10:00 AM the next work ing day after each day that work is performed;

b. QC Specialist Reports and Test Results: Originals and 1 copy, by 10:00 AM the next working day after each day that work is per formed;

c. Testing Plan and Log, 1 copy, at the end of each month;

d. QC Meeting Minutes: 1 copy, within 2 calendar days of the meeting;

e. Rework Items List: 1 copy, by the last working day of the month and;

f. QC Certifications: As required by the paragraph entitled "QC Certifications".

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Organization, a QC Plan, attending a QC Plan meet ing, attending a Coordination and Mutual Understanding Meeting, conducting QC meetings, performing three phases of control, performing submittal review, ensuring testing is performed, and preparing QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program shall cover construction operations on-site and off-site and shall be keyed to the proposed construction sequence.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to manage and implement the QC program. The QC Manager is required to attend the QC Plan meeting, attend the Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control, perform submittal review, ensure testing is performed and prepare QC certifications and documentation required in this Contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by the QC specialists. In addition to managing and implementing the QC program, the QC Manager may perform the duties of project superintendent on projects less than $3 million.

1.5.1.2 Qualifications

An individual with a minimum of five years experience as a foreman, super intendent, inspector, QC Manager, project manager, or construction manager on similar size construction contracts which included the major trades that are part of this Contract.

1.5.1.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager shall have completed the course entitled "Construction Quality Management for Contractors." This course is periodically offered by the

Navy and the Corps of Engineers. However, it is sponsered by both the AGC and the ABC of Charlotte, North Carolina. Call one of the following to sign up for the next available class:

The Army Corps of Engineers, Baltimore District;
(Offered in Baltimore, MD)
Contact: Corps of Engineers, Baltimore District
10 South Howard Street
Baltimore, MD 21201
Phone: 410-962-2323

The Associated General Contractors (AGC), Virginia Chapter
in Cooperation with the Army Corps of Engineers, Norfolk District, and
the Naval Facilities Engineering Command, Atlantic Division.
(Offered at rotating locations in Norfolk, Williamsburg, and Richmond)
Contact: AGC of Virginia
8631 Maylan Drive, Parham Park
Richmond, VA 23294
Phone: 804-346-3383

Carolinas Associated General Contractors (CACG)
Contact: CACG
1100 Euclid Avenue
Charlotte, NC 28203
Phone: 704-372-1450 (ext. 5248)

Associated Builders and Contractors (ABC), Carolinas Chapter
Contact: ABC, Carolinas Chapter
3705 Latrobe Drive
Charlotte, NC 28211
Phone: 704-367-1331
or: 877-470-4819

1.5.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be three years of experience in one of the specified positions.

1.6 QC PLAN

1.6.1 Requirements

Provide for approval by the Contracting Officer, a QC plan submitted in a 3-ring binder with pages numbered sequentially that covers, both on-site and off-site work and includes, the following:

a. A table of contents listing the major sections identified with tabs in the following order:

I. QC ORGANIZATION
II. NAMES AND QUALIFICATIONS
III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL
IV. OUTSIDE ORGANIZATIONS
V. APPOINTMENT LETTERS
VI. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER
VII. TESTING LABORATORY INFORMATION

VIII. TESTING PLAN AND LOG
IX. PROCEDURES TO COMPLETE REWORK ITEMS
X. DOCUMENTATION PROCEDURES
XI. LIST OF DEFINABLE FEATURES
XII. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL
XIII. PERSONNEL MATRIX
XIV. PROCEDURES FOR COMPLETION INSPECTION

b. A chart showing the QC organizational structure and its relationship to the production side of the organization.

c. Names and qualifications, in resume format, for each person in the QC organization.

d. Duties, responsibilities and authorities of each person in the QC organization.

e. A listing of outside organizations such as, architectural and consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.

f. A letter signed by an officer of the firm appointing the QC Manager and stating that he/she is responsible for managing and implementing the QC program as described in this contract. Include in this letter the QC Manager's authority to direct the removal and replacement of non-conforming work.

g. Procedures for reviewing, approving and managing submittals. Provide the names of the persons in the QC organization authorized to review and certify submittals prior to approval.

h. Testing laboratory information required by the paragraphs entitled "Accredited Laboratories" or "Testing Laboratory Requirements", as applicable.

i. A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

j. Procedures to identify, record, track and complete rework items.

k. Documentation procedures, including proposed report formats.

l. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and requires separate control requirements. As a minimum, if approved by the Contracting Officer, consider each Section of the Specifications as a definable feature of work. However, at times, there may be more than one definable feature of work in each Section of the Specifications.

m. A personnel matrix showing, for each section of the specification, who will perform and document the three phases of control, and who will perform and document the testing.

o. Procedures for Identifying and Documenting the Completion Inspection process. Include in these procedures the responsible party for punch out inspection, prefinal inspection, and final

acceptance inspection.

1.6.2 Preliminary Work Authorized Prior to Approval

The only work that is authorized to proceed prior to the approval of the QC plan is mobilization of storage and office trailers and surveying.

1.6.3 Approval

Approval of the QC plan is required prior to the start of construction. The Contracting Officer reserves the right to require changes in the QC plan and operations as necessary to ensure the specified quality of work. The Contracting Officer reserves the right to interview any member of the QC organization at any time in order to verify his/her submitted qualifications.

1.6.4 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes must be approved by the Contracting Officer.

1.7 QC PLAN MEETING

Prior to submission of the QC plan, meet with the Contracting Officer to discuss the QC plan requirements of this Contract. The purpose of this meeting is to develop a mutual understanding of the QC plan requirements prior to plan development and submission.

1.8 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, but prior to the start of construction, meet with the Contracting Officer to discuss the QC program required by this Contract. The purpose of this meeting is to develop a mutual understanding of the QC details, including forms to be used for documentation, administration for on-site and off-site work, and the coordination of the Contractor's management, production and QC personnel with the Contracting Officer. As a minimum, the Contractor's personnel required to attend shall include the project manager, project superintendent, and QC Manager. Minutes of the meeting shall be prepared by the QC Manager and signed by both the Contractor and the Contracting Officer.

1.9 QC MEETINGS

After the start of construction, the QC Manager shall conduct weekly QC meetings at the work site with the project superintendent and QC specialists. The QC Manager shall prepare the minutes of the meeting and provide a copy to the Contracting Officer within 2 working days after the meeting. The Contracting Officer may attend these meetings. The QC Manager shall notify the Contracting Officer at least 48 hours in advance of each meet ing. As a minimum, the following shall be accomplished at each meeting:

a. Review the minutes of the previous meeting;

b. Review the schedule and the status of work:

- Work or testing accomplished since last meeting
- Rework items identified since last meeting
- Rework items completed since last meeting;

c. Review the status of submittals:

- Submittals reviewed and approved since last meeting
- Submittals required in the near future;

d. Review the work to be accomplished in the next 2 weeks and documen tation required. Schedule the three phases of control and testing:

- Establish completion dates for rework items
- Preparatory phases required
- Initial phases required
- Follow-up phases required
- Testing required
- Status of off-site work or testing
- Documentation required;

e. Resolve QC and production problems; and

f. Address items that may require revising the QC plan:

- Changes in QC organization personnel
- Changes in procedures.

1.9.1 THREE PHASES OF CONTROL

The QC Manager shall perform the three phases of control to ensure that work complies with Contract requirements. The Three Phases of Control shall adequately cover both on-site and off-site work and shall include the following for each definable features of work: A definable feature of work is a task which is separate and distinct from other tasks and requires separate control requirements.

1.9.2 Preparatory Phase

Notify the Contracting Officer at least 48 hours in advance of each preparatory phase. Conduct the preparatory phase with the superintendent, and the foreman responsible for the definable feature. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report. Perform the following prior to beginning work on each definable feature of work:

a. Review each paragraph of the applicable specification sections;

b. Review the Contract drawings;

c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;

d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;

e. Examine the work area to ensure that the required preliminary work has been completed;

f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;

g. Review the safety plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted; and

h. Discuss construction methods

1.9.3 Initial Phase

Notify the Contracting Officer at least 48 hours in advance of each initial phase. When construction crews are ready to start work on a definable feature of work, conduct the initial phase with the QC Specialists, the super intendent, and the foreman responsible for that definable feature of work. Observe the initial segment of the definable feature of work to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily Contractor Quality Control Report. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each definable feature of work:

a. Establish the quality of workmanship required;

b. Resolve conflicts;

c. Review the Safety Plan and the appropriate activity hazard analysis to ensure that applicable safety requirements are met; and

d. Ensure that testing is performed by an approved laboratory.

1.9.4 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary until the completion of each definable feature of work and document in the daily Contractor Quality Control Report:

a. Ensure the work is in compliance with Contract requirements;

b. Maintain the quality of workmanship required;

c. Ensure that testing is performed by an approved laboratory; and

d. Ensure that rework items are being corrected.

1.9.5 Notification of Three Phases of Control for Off-Site Work

Notify the Contracting Officer at least two weeks prior to the start of the preparatory and initial phases.

1.10 SUBMITTAL REVIEW

Procedures for submittals are as described in Section entitled "Submittal Procedures."

1.11 TESTING

Except as stated otherwise in the specification sections, perform sampling

and testing required under this Contract.

1.11.1 Testing Laboratory Requirements

Provide an independent testing laboratory or establish a laboratory quali fied to perform sampling and tests required by this Contract. When the proposed testing laboratory is not accredited by an acceptable accreditation program as described by the paragraph entitled "Accredited Laboratories", submit to the Contracting Officer for approval, certified statements signed by an official of the testing laboratory attesting that the proposed laboratory meets or conforms to the following requirements:

a. Sampling and testing shall be under the technical direction of a Registered Professional Engineer (P.E) with at least 5 years of experience in construction material testing.

b. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C 1077.

c. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D 3666.

d. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall meet the requirements of ASTM D 3740.

e. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A 880. Laboratories shall meet the requirements of ASTM E 329.

f. Laboratories engaged in nondestructive testing (NDT) shall meet the requirements of ASTM E 543.

g. Laboratories engaged in hazardous materials testing shall meet the requirements of OSHA and EPA.

1.11.2 Accredited Laboratories

Acceptable accreditation programs are the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO) program and the American Association for Laboratory Accreditation (A2LA) program. Furnish to the Contracting Officer, a copy of the Certificate of Accreditation, Scope of Accreditation and latest directory of the accrediting organization for accredited laboratories. The scope of the laboratory's accreditation shall include the test methods required by the Contract.

1.11.3 Inspection of Testing Laboratories

Prior to approval of non-accredited laboratories, the proposed testing laboratory facilities and records shall be subject to inspection by the Contracting Officer. Records subject to inspection include equipment inventory, equipment calibration dates and procedures, library of test procedures, audit and inspection reports by agencies conducting laboratory evaluations and certifications, testing and management personnel qualifications, test report forms, and the internal QC procedures.

1.11.4 Capability Check

The Contracting Officer retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

1.11.5 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the Contracting Officer via the QC Manager. Furnish a summary report of field tests at the end of each month. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month.

1.12 QC CERTIFICATIONS

1.12.1 Contractor Quality Control Report Certification

Each Contractor Quality Control Report shall contain the following statement: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report".

1.12.2 Invoice Certification

Furnish a certificate to the Contracting Officer with each payment request, signed by the QC Manager, attesting that as-built drawings are current and attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

1.12.3 Completion Certification

Upon completion of work under this Contract, the QC Manager shall furnish a certificate to the Contracting Officer attesting that "the work has been completed, inspected, tested and is in compliance with the Contract".

1.13 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.13.1 Contractor Production Report

Reports are required for each day that work is performed and shall be attached to the Contractor Quality Control Report prepared for the same day. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Production Reports are to be prepared, signed and dated by the project superintendent and shall contain the following information:

a. Date of report, report number, name of contractor, contract number, title and location of Contract and superintendent present.

b. Weather conditions in the morning and in the afternoon including maximum and minimum temperatures.

c. A list of Contractor and subcontractor personnel on the work site, their trades, employer, work location, description of work performed and hours worked.

e. A list of job safety actions taken and safety inspections conducted. Indicate that safety requirements have been met including the results on the following:

(1) Was a job safety meeting held this date? (If YES, attach a copy of the meeting minutes.)

(2) Were there any lost time accidents this date? (If YES, attach a copy of the completed OSHA report.)

(3) Was crane/manlift/trenching/scaffold/hv electrical/high work/hazmat work done? (If YES, attach a statement or checklist showing inspection performed.)

(4) Was hazardous material/waste released into the environment? (If YES, attach a description of incident and proposed action.)

f. A list of safety actions taken today and safety inspections conducted.

g. A list of equipment/material received each day that is incorporated into the job.

h. A list of construction and plant equipment on the work site including the number of hours used, idle and down for repair.

i. Include a "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site.

1.13.2 Contractor Quality Control Report

Reports are required for each day that work is performed and for every seven consecutive calendar days of no-work and on the last day of a no-work period. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Quality Control Reports are to be prepared, signed and dated by the QC Manager and shall contain the following information:

a. Identify the control phase and the definable feature of work.

b. Results of the Preparatory Phase meetings held including the location of the definable feature of work and a list of personnel

present at the meeting. Indicate in the report that for this definable feature of work, the drawings and specifications have been reviewed, submittals have been approved, materials comply with approved submittals, materials are stored properly, preliminary work was done correctly, the testing plan has been reviewed, and work methods and schedule have been discussed.

c. Results of the Initial Phase meetings held including the location of the definable feature of work and a list of personnel present at the meeting. Indicate in the report that for this definable feature of work the preliminary work was done correctly, samples have been prepared and approved, the workmanship is satisfactory, test results are acceptable, work is in compliance with the Contract, and the required testing has been performed and include a list of who performed the tests.

d. Results of the Follow-up Phase inspections held including the location of the definable feature of work. Indicate in the report for this definable feature of work that the work complies with the Contract as approved in the Initial Phase, and that required testing has been performed and include a list of who performed the tests.

e. Results of the three phases of control for off-site work, if applicable, including actions taken.

f. List the rework items identified, but not corrected by close of business.

g. List the rework items corrected from the rework items list along with the corrective action taken.

h. Include a "remarks" section in this report which will contain pertinent information including directions received, quality control problem areas, deviations from the QC plan, construction deficiencies encountered, QC meetings held, acknowledgement that as-built drawings have been updated, corrective direction given by the QC Organization and corrective action taken by the Contractor.

i. Contractor Quality Control Report certification.

1.13.3 Testing Plan and Log

As tests are performed, the QC Manager shall record on the "Testing Plan and Log" the date the test was conducted, the date the test results were forwarded to the Contracting Officer, remarks and acknowledgement that an accredited or Contracting Officer approved testing laboratory was used. Attach a copy of the updated "Testing Plan and Log" to the last daily Contractor Quality Control Report of each month.

1.13.4 Rework Items List

The QC Manager shall maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Contractor Rework Items List" to the last daily Contractor Quality Control Report of each month. The Contractor shall be responsible for including on this list items needing rework

including those identified by the Contracting Officer.

1.13.5 As-Built Drawings

The QC Manager is required to review the as-built drawings required by Section 01 11 00, "Summary of Work", to ensure that as-built drawings are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. The QC Manager shall initial each deviation and each revision. Upon completion of work, the QC Manager shall furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

1.13.6 Report Forms

The following forms, which are attached at the end of this section, are acceptable for providing the information required by the paragraph entitled "Documentation". While use of these specific formats are not required, any other format used shall contain the same information:

a. Combined Contractor Production Report and Contractor Quality Control Report (1 sheet), with separate continuation sheet

b. Testing Plan and Log

c. Rework Items List

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

CONTRACTOR PRODUCTION REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

CONTRACT NO	TITLE AND LOCATION	DATE
		REPORT NO
CONTRACTOR	SUPERINTENDENT	
AM WEATHER	PM WEATHER	MAX TEMP F / MIN TEMP F

WORK PERFORMED TODAY

Schedule Activity No.	WORK LOCATION AND DESCRIPTION	EMPLOYER	NUMBER	TRADE	HRS

JOB SAFETY

WAS A JOB SAFETY MEETING HELD THIS DATE? (If YES attach copy of the meeting minutes)	☐ YES ☐ NO	TOTAL WORK HOURS ON JOB SITE THIS DATE
WERE THERE ANY LOST TIME ACCIDENTS THIS DATE? (If YES attach copy of completed OSHA report)	☐ YES ☐ NO	
WAS CRANE/MANLIFT/TRENCHING/SCAFFOLD/HV ELECTRICAL/HIGH WORK DONE? (If YES attach statement or checklist showing inspection performed)	☐ YES ☐ NO	CUMULATIVE TOTAL OF WORK HOURS FROM PREVIOUS REPORT
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? (If YES attach description of incident and proposed action)	☐ YES ☐ NO	TOTAL WORK HOURS FROM START OF CONSTRUCTION

LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED

☐ SAFETY REQUIREMENTS HAVE BEEN MET.

EQUIPMENT/MATERIAL RECEIVED TODAY TO BE INCORPORATED IN JOB

CONSTRUCTION AND PLANT EQUIPMENT ON JOB SITE TODAY. INCLUDE NUMBER OF HOURS USED TODAY

REMARKS

CONTRACTOR/SUPERINTENDENT DATE

COMBINED FORM 01450-1 (7/96)

SHEET OF

CONTRACTOR QUALITY CONTROL REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

PHASE	(BLANK NOT APPLICABLE)	YES	NO	IDENTIFY SPECIFICATION SECTION, DEFINABLE FEATURE OF WORK, LOCATION AND LIST PERSONNEL PRESENT
PREPARATORY	PLANS AND SPECS HAVE BEEN REVIEWED	☐	☐	
	THE SUBMITTALS HAVE BEEN APPROVED.	☐	☐	
	MATERIALS COMPLY WITH APPROVED SUBMITTALS	☐	☐	
	MATERIALS STORED PROPERLY.	☐	☐	
	PRELIMINARY WORK WAS DONE CORRECTLY.	☐	☐	
	TESTING PLAN HAS BEEN REVIEWED.	☐	☐	
	WORK METHOD AND SCHEDULE DISCUSSED.	☐	☐	
	JOB SAFETY / HAZARD ANALYSIS ADDRESSED	☐	☐	
INITIAL	PRELIMINARY WORK WAS DONE CORRECTLY	☐	☐	TESTING PERFORMED & WHO PERFORMED TEST
	SAMPLE HAS BEEN PREPARED/APPROVED	☐	☐	
	WORKMANSHIP IS SATISFACTORY	☐	☐	
	TEST RESULTS ARE ACCEPTABLE.	☐	☐	
	WORK IS IN COMPLIANCE WITH THE CONTRACT.	☐	☐	
	WORK COMPIES WITH SAFETY REQUIREMENTS	☐	☐	
FOLLOW-UP	WORK COMPLIES WITH CONTRACT AS APPROVED INITIAL PHASE	☐	☐	TESTING PERFORMED & WHO PERFORMED TEST
	WORK COMPIES WITH SAFETY REQUIREMENTS	☐	☐	

REWORK ITEMS IDENTIFIED TODAY (NOT CORRECTED BY CLOSE OF BUSINESS)

REWORK ITEMS CORRECTED TODAY (FROM REWORK ITEMS LIST)

REMARKS

On behalf of the contractor, I certify that this report is completed and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.

AUTHORIZED QC MANAGER AT SITE DATE

GOVERNMENT QUALITY ASSURANCE REPORT

DATE

QUALITY ASSURANCE REPRESENTATIVE'S REMARKS AND/OR EXCEPTIONS TO THE REPORT

GOVERNMENT QUALITY ASSURANCE MANAGER DATE

COMBINED FORM 01450-1 (7/96) (BACK) SHEET OF

CONTRACTOR QUALITY CONTROL REPORT CONTINUATION SHEET

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

PHASE	(BLANK NOT APPLICABLE)	YES	NO	IDENTIFY SPECIFICATION SECTION, DEFINABLE FEATURE OF WORK, LOCATION AND LIST PERSONNEL PRESENT
PREPARATORY	PLANS AND SPECS HAVE BEEN REVIEWED	☐	☐	
	THE SUBMITTALS HAVE BEEN APPROVED.	☐	☐	
	MATERIALS COMPLY WITH APPROVED SUBMITTALS	☐	☐	
	MATERIALS STORED PROPERLY.	☐	☐	
	PRELIMINARY WORK WAS DONE CORRECTLY.	☐	☐	
	TESTING PLAN HAS BEEN REVIEWED.	☐	☐	
	WORK METHOD AND SCHEDULE DISCUSSED.	☐	☐	
	JOB SAFETY / HAZARD ANALYSIS ADDRESSED	☐	☐	

INITIAL				TESTING PERFORMED & WHO PERFORMED TEST
	PRELIMINARY WORK WAS DONE CORRECTLY	☐	☐	
	SAMPLE HAS BEEN PREPARED/APPROVED	☐	☐	
	WORKMANSHIP IS SATISFACTORY	☐	☐	
	TEST RESULTS ARE ACCEPTABLE.	☐	☐	
	WORK IS IN COMPLIANCE WITH THE CONTRACT.	☐	☐	
	WORK COMPLIES WITH SAFETY REQUIREMENTS	☐	☐	

COMBINED FORM 01450-2 (7/96)

CONTRACTOR QUALITY CONTROL REPORT CONTINUATION SHEET (ATTACH ADDITIONAL SHEETS IF NECESSARY)				DATE
PHASE	(BLANK NOT APPLICABLE)	YES	NO	IDENTIFY SPECIFICATION SECTION, DEFINABLE FEATURE OF WORK, LOCATION AND LIST PERSONNEL PRESENT
FOLLOW-UP	WORK COMPLIES WITH CONTRACT AS APPROVED INITIAL PHASE	☐	☐	
	WORK COMPLIES WITH SAFETY REQUIREMENTS	☐	☐	

COMBINED FORM 01450-2 (7/96)

TESTING PLAN AND LOG

CONTRACT NUMBER			PROJECT TITLE AND LOCATION							CONTRACTOR	
SPECIFICATION SECTION AND PARAGRAPH NUMBER	ITEM OF WORK	TEST REQUIRED	ACCREDITED/ APPROVED LAB		SAMPLED BY	TESTED BY	LOCATION OF TEST		DATE COMPLETED	DATE FORWARDED TO CONTR. OFF.	REMARKS
			YES	NO			ON SITE	OFF SITE			

REWORK ITEMS LIST

Contract No. and Title: ______________________________

Contractor: ______________________________

NUMBER	DATE IDENTIFIED	DESCRIPTION	CONTRACT REQUIREMENT (Spec. Section and Par. No., Drawing No. and Detail No., etc.)	ACTION TAKEN BY QC MANAGER	RESOLUTION	DATE COMPLETED

-- End of Section --

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C511	(1997) Reduced-Pressure Principle Backflow-Prevention Assembly

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-01	(1993) Manual of Cross-Connection Control
FCCCHR-USC	(1992) List of Approved Backflow Prevention Assemblies

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA MUTCD	(1988) Manual on Uniform Traffic Control Devices

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-01 Preconstruction Submittals

Traffic control plan

SD-03 Product Data

Backflow preventers

SD-06 Test Reports

Backflow Preventer Tests

SD-07 Certificates

Backflow Tester Certifications

Backflow Preventers Certificate of Full Approval

1.3 BACKFLOW TESTER CERTIFICATIONS

Certificate of Full Approval from FCCCHR-USC, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.3.1 Backflow Preventers Certificate

The Contractor shall submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours or training in backflow preventer installations. The certificate must be current.

1.4 TEMPORARY UTILITIES

1.4.1 Availability of Utility Services

a. The Contract clause related to utilities applies. Reasonable amounts of water and electricity from the nearest outlet will be provided free of charge for pursuance of work within a facility under this contract. If the nearest available outlet cannot be utilized by the Contractor because of improper voltage, insufficient current, improper pressure, incompatible connectors, etc., it shall be the responsibility of the Contractor to provide temporary utilities as required.

b. Reasonable amounts of utilities for contractor trailers and storage buildings will be made available to the Contractor, when available. The Contractor shall be responsible for providing transformers, electrical service poles and drops for electrical services, and backflow preventer devices on connections to domestic water lines. Final taps and tie-ins to the Government utility grid will be made by the Contractor after approval by the Contracting Officer. Tap-in cost, if any, shall be the responsibility of the Contractor. Under no circumstances will taps to base fire hydrants be allowed for obtaining domestic water.

1.4.2 Trailers

Electrical service will be supplied by the Government, when available, except at Tarawa Terrace where Progress Energy will be the supplier.

1.4.3 Energy and Utilities Conservation

The Contractor shall carefully conserve utilities furnished without charge. The Contractor, at his own expense and in a manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines and remove the same prior to final acceptance of the construction.

1.4.4 Location of Underground Utilities

Location and Protection of underground utilities shall be the responsibility of the Contractor. Where existing-to-remain piping, utilities, and underground obstructions of any type are indicted in locations to be traversed by new piping, ducts, and other excavations the elevations of the existing utilities and obstructions shall be determined

before the new work is completed.

a. In addition, the Contractor will be responsible for obtaining the services of a professional utility locator prior to digging. Contractor will provide documentation that the site has been surveyed and checked for underground utilities. All utilities must be located, including but not limited to power, water, sewer, storm drains, fiber optics, T.V. cable, telephone, and intrusion detection wiring. A set of known utility drawings will be available in the ROICC office for review to assist the locator.

b. It is mandatory that the Contractor also contact the Base Telephone Office (451-2531) prior to accomplishing any digging at Camp Lejeune. A telephone office representative will assist in locating telephone lines.

c. It is mandatory that the Contractor also contact Charter Communications, cable TV service prior to accomplishing any digging at Camp Lejeune, to ensure that all buried cable lines are identified. Contact Mr. Olin Criswell at 353-8677 for assistance.

1.4.4.1 The Locations of Underground Utilities shown at only approximate and the information provided may be incomplete. Contractor shall attempt to ascertain locations of existing underground utilities prior to and during digging operations.

1.4.4.2 Damage to Underground Utilities

Immediate notice shall be delivered to the Contracting Officer of any damage. The Contractor shall make temporary repairs immediately, and shall provide permanent repairs as soon as practicable. For any additional work required by reason of conflict between the new and existing work, an adjustment in contract price will be made in accordance with Contract clause entitled "Differing Site Conditions", if appropriate.

1.5 WEATHER PROTECTION

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

1.5.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions shall include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

1.5.1.1 Hurricane Conditions of Readiness

Unless directed otherwise, comply with:

a. Condition FIVE: Normal weather conditions are expected for the

foreseeable future. No action is required.

b. Condition FOUR (Sustained winds of 74 mph or greater expected within 72 hours): Contractors shall continue normal daily clean up and good house keeping practices. Collect and store in piles or containers scrap lumber, waste material, and rubbish for removal and disposal at the close of each work day. Stack lumber in neat piles less than 4 feet high. Prepare to remove or secure all debris, trash, or stored materials that could become missile hazards during high wind conditions. Meetings should be held on-site with all subcontractors to review the measures that are going to need to be taken should the base go to a higher readiness condition. Contact the ROICC for any additional updates and upon completion of all required actions.

c. Condition THREE (Sustained winds of 74 mph or greater expected within 48 hours): Once Condition 3 is set, contractors shall shift their focus from their normal activities to taking the actions that are required to prepare the job site for the potential of destructive weather. All debris and rubbish shall be removed form the site at the end of the workday. All stored materials shall either be removed from the job site or secured (metal straps or heavy lines/ropes). All tools, equipment and gear shall be secured at the end of the workday. Begin preparations to adequately secure the facility (windows boarded up, etc.). Meetings should be held on-site with all subcontractors to review the measures that are going to be taken should base go to a higher readiness condition. Contract the ROICC for any additional updates and upon completion of all required actions.

d. Condition TWO (Sustained winds of 74 mph or greater expected within 24 hours): Cease all normal activities until the job-site is completely prepared for the onslaught of destructive weather. The job site should be completely free of debris, rubbish and scrap materials. The facility being worked on should be made weather-tight. All scaffolding planking shall be removed. All formwork and free standing structural steel shall be braced. All machinery, tools, equipment and materials shall be properly secured or removed from the job-site. Expend every effort to clear all missiles hazards and loose equipment from the job site. When the contractor secures for the day the job site should be left in a condition that is ready for the storm and the contractor should assume that they will not be allowed to return to their job site until after the storm passes and the base is reopened. Contact ROICC for additional updates and upon completion of required actions.

e. Condition ONE (Sustained winds of 74 mph or greater expected within 12 hours): If still on the job site, the contractor will be required to immediately leave the base until the storm passes and the base is reopened.

1.6 STATION OPERATION AFFECT ON CONTRACTOR OPERATIONS

1.6.1 Special Restrictions Regarding Access of Vehicles and Parking

1.6.1.1 Interruption of Vehicular Traffic

If during the performance of work, it becomes necessary to modify vehicular traffic patterns at any locations, notify the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan shall be in accordance with State and local regulations and the FHWA MUTCD, Part VI. Provide cones, signs, barricades, lights, or other traffic control devices and personnel required to control traffic.

1.7 STORAGE AREAS

The Contract Clause entitled "FAR 52.236-10, Operations and Storage Areas" and the following apply:

1.7.1 Storage in Existing Buildings

The Contractor shall be working in and around existing buildings; the storage of material will not be allowed in the buildings.

1.8 TEMPORARY SANITARY FACILITIES

Provide adequate sanitary conveniences of a type approved for the use of persons employed on the work, properly secluded from public observation, and maintained in such a manner as required and approved by the Contracting Officer. Maintain these conveniences at all times without nuisance. Upon completion of the work, remove the conveniences from the premises, leaving the premises clean and free from nuisance. Dispose of sewage through connection to a municipal, district, or station sanitary sewage system. Where such systems are not available, use chemical toilets or comparably effective units, and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Include provisions for pest control and elimination of odors.

1.9 TEMPORARY BUILDINGS

Locate these where directed and within the indicated operations area.

1.9.1 Maintenance of Temporary Facilities

Suitably paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

1.9.2 Trailers or Storage Buildings

Trailers or storage buildings will be permitted, where space is available, subject to the approval of the Contracting Officer. The trailers or buildings shall be in good condition, free from visible damage rust and deterioration, and meet all applicable safety requirements. Trailers shall be roadworthy and comply with all appropriate state and local vehicle requirements. Failure to maintain storage trailers or buildings to these standards shall result in the removal of non-complying units at the Contractor's expense. A sign not smaller than 24 by 24 inches shall be conspicuously placed on the trailer depicting the company name, business

phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state of local standards for anchoring mobile trailers.

PART 2 PRODUCTS

2.1 Backflow Preventers

Reduced pressure principle type conforming to the applicable requirements AWWA C511. Provide backflow preventers complete with 150 pound flanged cast iron, bronze, brass mounted gate valve and strainer, 304 stainless steel or bronze, internal parts. The particular make, model/design, and size of backflow preventers to be installed shall be included in the latest edition of the List of Approved Backflow Prevention Assemblies issued by the FCCCHR-USC and shall be accompanied by a Certificate of Full Approval from FCCCHR-USC.

- or -

Not used.

PART 3 EXECUTION

3.1 REDUCED PRESSURE BACKFLOW PREVENTERS

Provide an approved reduced pressure backflow prevention assembly at each location where the Contractor taps into the Government potable water supply.

A certified tester(s) shall perform testing of backflow preventer(s) for proper installation and operation and provide subsequent tagging. Backflow preventer tests shall be performed using test equipment, procedures, and certification forms conforming to those outlined in the latest edition of the Manual of Cross-Connection Control published by the FCCCHR-01. Test and tag each reduced pressure backflow preventer upon initial installation. Tag shall contain the following information: make, model, serial number, dates of tests, results, maintenance performed, and signature of tester. Record test results on certification forms conforming to requirements cited earlier in this paragraph.

Not used.

-- End of Section --

SECTION 01 54 30

WORK RESTRICTIONS IN LANDING AREAS

07/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE EM-385-1-1	(1996) Safety and Health Requirements Manual

1.2 EMERGENCY LIGHTING, SIGNALS, AND ELIMINATION OF HAZARDS

The operation of all ground equipment, mobile or stationary, required for construction, repairs, or any other purpose within the landing areas of the airdrome shall be governed by COE EM-385-1-1, as modified herein. The term "landing area" shall include all runways, taxiways, and tactical landing zones plus 75 feet on each side and a zone 1,000 feet long at each end of each runway, or to within 50 feet of the boundary of the airport.

1.2.1 Marking Hazardous Areas

Landing areas hazardous to aircraft shall be outlined by yellow flags by day and red lanterns by night, except that where contact lights outline the runway no red lanterns shall be placed on obstructions outside the contact light area.

1.2.2 Marking of Equipment

All equipment and materials in the landing area shall be marked with yellow flags by day and red lanterns by night, except where contact lights outline the runway, no red lanterns shall be placed on obstructions outside the contact light area, and except that mobile equipment shall not remain in the landing area at night.

1.2.3 Obstruction of landing Areas

Nothing shall be placed upon a landing area without authority of the Officer in Charge. Neither equipment nor personnel shall use any runway for any purpose unless the runway is closed by order of the Officer in Charge and marked as specified above.

1.2.4 Notification

The Contractor shall report to the Officer in Charge before initiating any work and shall notify the Officer in Charge of proposed changes of locations of operations. Additional permission must, in each and every instance, be obtained before entering a landing area with automotive equipment, trucks, trenchers, cranes, or similar equipment.

1.2.5 Coordination

The Contractor shall coordinate the construction work with the Officer in Charge and the Contracting Officer. Temporary connection of the system may be required for emergency lighting. in case emergency lighting is required and temporary connections are made, an adjustment in the contract price and/or time for completion of the work will be executed in the same manner as provided by Contract Clauses subject to the requirements of notifications thereunder being given.

1.2.6 "Officer in Charge"

As used herein "Officer in Charge" means the Station Air Operation's Officer or his designee. Initial contact and continuing relationships between the Officer in Charge and the Contractor will be coordinated by the Contracting Officer.

1.3 AIRFIELD SAFETY PRECAUTIONS

The operation of all ground equipment (mobile or stationary) the placement of all materials, and the performance of all work, upon and in the vicinity of all airfields, shall be done in accordance with DFARS 252.236-7005, "Airfield Precautions", contained in Contract Clauses.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01 54 40

PROCEDURES FOR ENTRY INTO DANGEROUS TRAINING AREAS

01/07

PART 1 GENERAL

1.1 DANGER AREAS

Danger from field firing, impacting shells or bombs, and other military ordnance and manuevers exists at all times in the training areas outside the built-up areas of Camp Lejeune.

1.2 SIGNS

Signs denoting such areas are usually marked "FIELD FIRING" or "IMPACT AREA". Other areas may be dangerous at times.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ENTRY

Entry into any area signed with "IMPACT AREA", "FIELD FIRING", OR "RANGE" will be made only after the Contractor receives written permission from the Range Safety Officer, who may be reached by telephone at (919)-451-3064.

3.2 CONTRACTOR PERSONNEL

Contractor personnel present in any area which appears to become under gunfire, shelling, bombing or any other apparent danger from military training operations, shall immediately evacuate the area of danger and notify the Officer in Charge of Construction at (919)-451-2581.

-- End of Section --

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

12/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-S-16165	(Rev E) Shielding Harnesses, Shielding Items and Shielding Enclosures for Use in the Reduction of Interference from Engine Electrical Systems
MIL-STD-461	(Rev E) Control of Electromagnetic Interference Emissions and Susceptibility
MIL-STD-462	(Rev D; Notice 4) Electromagnetic Interference Characteristics

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 832-R-92-005	(1992) Storm Water Management for Construction Activities

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
40 CFR 122.26	EPA National Pollutant Discharge Elimination System Permit Regulations
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
49 CFR 171	General Information, Regulations, and Definitions

49 CFR 172	Hazardous Materials Tables and Hazardous Materials Communications Regulations
49 CFR 178	Shipping Container Specification

1.2 Contractor Liabilities for Environmental Protection

Contractors shall complete and provide environmental training documentation for training required by Federal, State, and local regulations.

1.3 DEFINITIONS

1.3.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.3.2 Solid Waste

Rubbish, debris, garbage, and other discarded solid materials, except recyclables and hazardous waste as defined in paragraph entitled "Hazardous Waste," resulting from industrial, commercial, and agricultural operations and from community activities.

1.3.3 Sanitary Wastes

Wastes characterized as domestic sanitary sewage.

1.3.4 Rubbish

Combustible and noncombustible wastes such as non-recyclable paper and cardboard, crockery, treated lumber, and bones.

Recyclables includes: clean paper, cardboard, glass, plastics (No. 1 & 2), metal, cans, untreated wood/lumber, and concrete.

Non-recyclable paper and cardboard are defined as material that has become wet or contaminated with food or other residue that render it un-acceptable for recycling.

Treated wood is defined as wood that has been stained or treated to prevent rot, or composit wood products such as OSB, pressboard furniture, etc.

1.3.5 Debris

Combustible and noncombustible wastes such as ashes and waste materials resulting from construction or maintenance and repair work, (excluding recyclables) leaves, and tree trimmings.

1.3.6 Chemical Wastes

This includes salts, acids, alkalies, herbicides, pesticides, and organic chemicals.

1.3.7 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.3.8 Hazardous Waste

Hazardous substances as defined in 40 CFR 261 or as defined by applicable State and local regulations.

1.3.9 Hazardous Materials

Hazardous materials as defined in 49 CFR 171 and listed in 49 CFR 172.

1.3.10 Landscape Features

Trees, plants, shrubs, and ground cover.

1.3.11 Lead Acid Battery Electrolyte

The electrolyte substance (liquid medium) within a battery cell.

1.3.12 Oily Waste

Petroleum products and bituminous materials.

1.3.13 Class I Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Sections 602 (a and b) of The Clean Air Act.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-01 Preconstruction Submittals

Environmental protection plan

Preconstruction survey report

MSDS for Class I ODS waivered product

Permit for storm water discharge

Notice of Intent

Notice of Termination

Pollution Prevention Plan

SD-06 Test Reports

Abrasive blasting waste materials

Submit a copy of an approved laboratory analysis of materials collected as a result from abrasive blasting operations before disposing of waste materials.

SD-11 Closeout Submittals

Solid waste disposal permit

Disposal permit for hazardous waste

Environmental training documentation

Permit to transport hazardous waste

Hazardous waste certification

Erosion and sediment control inspection reports

Environmental Plan Review

Annual Report of Products Containing Recovered Materials

1.4.1 Solid Waste Disposal Permit

Submit one copy of a State and local permit or license for the solid waste disposal facility. If the contract permists the use of the Base Landfill, request a letter from the Contracting Offcier authorizing permission to dump on base; submit the letter to the Base Landfill Office. In lieu of the letter a copy of the contract must be delivered to the Landfill Office for review.

1.4.2 Disposal Permit for Hazardous Waste

Submit a copy of the applicable EPA and State permits, manifests, or licenses for transportation, treatment, storage, and disposal of hazardous waste by permitted facilities.

1.4.3 Permit to Transport Hazardous Waste

Submit one copy of the EPA or State permit license, or regulation for the transporter who will ship the hazardous waste to the permitted Treatment, Storage, and Disposal (TSD) facility.

1.4.4 Hazardous Waste Certification

Submit written certification that hazardous waste turned in for disposal was generated on Government property and is identified, packaged, and labeled in accordance with 40 CFR 261, 40 CFR 262, and 40 CFR 263.

1.4.5 Erosion and Sediment Control Inspection Reports

Submit to the Contracting Officer once every 7 calendar days and within 24 hours of a storm event that produces 0.5 inch of rain.

1.5 ENVIRONMENTAL PROTECTION REGULATORY REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined in this Section. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including but not limited to water, air, solid waste, and noise pollution.

1.6 ENVIRONMENTAL PROTECTION PLAN

1.6.1 Contents of Environmental Protection Plan

a. Include any hazardous materials (HM) planned for use on the station shall be included in the station HM Tracking Program maintained by the Safety Department. To assist this effort, submit a list (including quantities) of HM to be brought to the station and copies of the corresponding material safety data sheets (MSDS). Submit this list to the Contracting Officer. At project completion, remove any hazardous material brought onto the station. Account for the quantity of HM brought to the station, the quantity used or expended during the job, and the leftover quantity which (1) may have additional useful life as a HM and shall be removed by the Contractor, or (2) may be a hazardous waste, which shall then be removed as specified herein.

b. The Environmental Protection Plan shall list and quantify any Hazardous Waste (HW) to be generated during the project.

c. In accordance with station regulations, store HW near the point of generation up to a total quantity of one quart of hazardous waste or 55 gallons of hazardous waste. Move any volume exceeding these quantities to a HW permitted area within 3 days. Prior to generation of HW, contact Contracting Officer for labeling requirements for storage of hazardous wastes.

d. In accordance with station regulations, substitute materials as necessary to reduce the generation of HW and include a statement to that effect in the Environmental Plan.

e. Contact Contracting Officer for conditions in the area of the project which may be subject to special environmental procedures. Include this information in the Preconstruction Survey. Describe in the Environmental Protection Plan any permits required prior to working the area, and contingency plans in case an unexpected environmental condition is discovered.

f. Obtain permits for handling HW, and deliver completed documents to Contracting Officer for review. File the documents with the appropriate agency, and complete disposal with the approval of Contracting Officer. Deliver correspondence with the State concerning the environmental permits and completed permits to Contracting Officer.

1.6.2 Environmental Protection Plan Format

The Environmental Protection Plan shall follow the following format:

ENVIRONMENTAL PROTECTION PLAN

Contractor Organization
Address and Phone Numbers

1. Hazardous materials to be brought onto the station
2. MSDS package
3. Employee training documentation
4. HW storage plan
5. HW to be generated

6. Preconstruction survey results
7. Permitting requirements identified

1.6.3 Environmental Plan Review

Fourteen days after the environmental protection meeting, submit the proposed environmental plan for further discussion, review, and approval.

1.6.4 Preconstruction Survey

Perform a preconstruction survey of the project site with the Contracting Officer, and take photographs showing or document existing environmental conditions in and adjacent to the site.

1.7 STORMWATER POLLUTION PREVENTION PLAN

40 CFR 122.26, EPA 832-R-92-005. Provide "Stormwater Pollution Prevention Plan."

a. Identify potential sources of pollution which may reasonably be expected to affect the quality of storm water discharge from the site.

b. Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge associated with industrial activity at the construction site.

c. Ensure compliance with terms of EPA general permit for storm water discharge.

d. Select applicable management practices from EPA 832-R-92-005 and _____.

e. Provide completed copy of Notice of Intent and Notice of Termination except for effective date.

1.7.1 Notice of Intent

The Contractor shall prepare a completed Notice of Intent (NOI) form in accordance with the requirements of the State's general permit for storm water discharges from construction sites. Submit NOI, and the appropriate permit fee to the Contracting Office a minimum of 14 days prior to start of construction.

The Contractor shall keep a copy of the approved permit on site at the Contractor's trailer at all times.

1.7.2 Class I and II ODS Prohibition

Class I ODS as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment, except a waiver has been obtained for _____. Contractor must provide MSDS for Class I ODS waivered product. This prohibition shall be considered to prevail over any other provision, specification, drawing, or referenced

documents.

1.8 ADMINISTRATIVE REQUIREMENTS

1.8.1 Licenses and Permits

Obtain licenses and permits pursuant to "FAR 52.236-7, Permits and Responsibilities" except for those permits which will be obtained by the Contracting Officer as follows:

a. _____

b. _____

For permits obtained by the Contracting Officer, whether or not required by the permit, perform inspections of the work in progress, and submit certifications to the applicable regulatory agency, via the Contracting Officer, that the work conforms to the contract and permit requirements. The inspections and certifications shall be provided through the services of a Professional Engineer, registered in the State where the work is being performed. As a part of the quality control plan, which is required to be submitted for approval by the quality control section, provide a subitem containing the name, P.E. registration number, address, and telephone number of the professional engineer(s) who will be performing the inspections and certifications for each permit listed above.

1.9 GENERAL ENVIRONMENTAL MANAGEMENT SYSTEM AND ENVIRONMENTAL AWARENESS

The Contractor shall familiarize himself with requirements of the attached "Marine Corps Base (MCB), Camp Lejeune, Contractor Environmental Guide."

1.10 CAMP LEJEUNE SANITARY LANDFILL INFORMATION SHEET

See attached "Camp Lejeune Sanitary Landfill Information Sheet" for hours of operation and other important information pertaining Landfill.

PART 2 PRODUCTS

2.1 ANNUAL REPORT OF PRODUCTS CONTAINING RECOVERED MATERIALS

The Contractor shall submit data annually (by December 1) products used during the previous fiscal year (October 1 - September 30) as required by 6002 of the Solid Waste Disposal Act as amended by Resource Conservation and Recovery Act (RCRA). Report forms is attached to end of this section as "Appendix A."

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified. Conform to the national or state permitting requirements of the Clean Water Act.

3.1.1 Land Resources

Except in areas to be cleared, do not remove, cut, deface, injure, or

destroy trees or shrubs without Contracting Officer's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by Contracting Officer. Where such use of attach ropes, cables, or guys is authorized, the Contractor shall be responsible for any resultant damage.

3.1.1.1 Protection of Trees

Protect existing trees which are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. By approved excavation, remove trees with 30 percent or more of their root systems destroyed. Removal of trees and the procedure for removal requires approval of the Contracting Officer.

3.1.1.2 Landscape Replacement

Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features. Obtain Contracting Officer's approval before removal or replacement.

3.1.1.3 Temporary Construction

Remove traces of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other signs of construction. Grade temporary roads, parking areas, and similar temporarily used areas to conform with surrounding contours.

3.1.2 Water Resources

3.1.2.1 Stream Crossings

The Contracting Officer's approval is required before any equipment will be permitted to ford live streams. In areas where frequent crossings are required, install temporary culverts or bridges. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition or as indicated or as specified.]

3.1.2.2 Oily Wastes

Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Surround all temporary fuel oil or petroleum storage tanks with a temporary earth berm of sufficient size and strength to contain the contents of the tanks in the event of leakage or spillage.

3.1.3 Fish and Wildlife Resources

Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

3.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Carefully protect in-place and report immediately to the Contracting Officer historical and archaeological items or human skeletal remains discovered in the course of work. Stop work in the immediate area of the

discovery until directed by the Contracting Officer to resume work. The Government retains ownership and control over historical and archaeological resources.

3.3 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives will not be permitted without written permission from the Contracting Officer, and then only during designated times. Confine pile-driving operations to the period between 8 a.m. and 4 p.m., Monday through Friday, exclusive of holidays, unless otherwise directed.

3.4 RESTRICTIONS ON EQUIPMENT

3.4.1 Electromagnetic Interference Suppression

a. Electric motors must comply with MIL-STD-461 relative to radiated and conducted electromagnetic interference. A test for electromagnetic interference will not be required for motors that are identical physically and electrically to those that have previously met the requirements of MIL-STD-461. An electromagnetic interference suppression test will not be required for electric motors without commutation or sliprings having no more than one starting contact and operated at 3,600 revolutions per minute or less.

b. Equipment used by the Contractor shall comply with MIL-S-16165for internal combustion engines and MIL-STD-461 for other devices capable of producing radiated or conducted interference.

c. Conduct tests for electromagnetic interference on electric motors and Contractor's construction equipment in accordance with MIL-STD-461 and MIL-STD-462. Test location shall be reasonably free from radiated and conducted interference. Furnish testing equipment, instruments, and personnel for making the tests; a test location; and other necessary facilities.

3.4.2 Radio Transmitter Restrictions

Conform to the restrictions and procedures for the use of radio transmitting equipment, as directed. Do not use transmitters without prior approval.

3.5 EROSION AND SEDIMENT CONTROL MEASURES

3.5.1 Local Erosion and Sediment Control Plan

Follow the approved storm water management, erosion and sediment control plan.

3.5.2 Burnoff

Burnoff of the ground cover is not permitted.

3.5.3 Borrow Pit Areas

Manage and control borrow pit areas to prevent sediment from entering nearby streams or lakes. Restore areas, including those outside the borrow

pit, disturbed by borrow and haul operations. Restoration includes grading, replacement of topsoil, and establishment of a permanent vegetative cover. Uniformly grade side slopes of borrow pit to not more than a slope of 1 part vertical to 2 parts horizontal. Uniformly grade the bottom of the borrow pits to provide a flat bottom and drain by outfall ditches or other suitable means. Stockpile topsoil removed during the borrow pit operation, and use as part of restoring the borrow pit area.

3.5.4 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified. Immediately protect side and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize duration of exposure of unprotected soils.

3.5.5 Temporary Protection of Erodible Soils

Use the following methods to prevent erosion and control sedimentation:

3.5.5.1 Mechanical Retardation and Control of Runoff

Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, berms, and use of silt fences and strawbales to retard and divert runoff to protected drainage courses.

3.5.5.2 Sediment Basins

Trap sediment in temporary or permanent sediment basins. Select a basin size to accommodate the runoff of a local _____-year storm. Pump dry and remove accumulated sediment, after each storm. Use a paved weir or vertical overflow pipe for overflow. Remove collected sediment from the site. Institute effluent quality monitoring programs.

3.5.5.3 Borrow

Permit only in areas where suitable environmental controls are possible.

3.5.5.4 Vegetation and Mulch

Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

a. Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish or re-establish a suitable stand of grass. Provide seeding as specified in Section _____, "_____."

3.6 CONTROL AND DISPOSAL OF SOLID WASTES

Pick up and separate solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean.

3.6.1 Disposal of Metal Paint Cans

All metal paint cans shall be taken to Building 962 for recycling. The cans shall be empty and completely dry. The cans shall be triple rinsed and stenciled "Triple Rinsed" prior to turn in. The Contractor shall give the Government 72 hours advance notice prior to turn-in. Contractor is responsible for rinsing, stenciling, crushing, and deposting in Government owned receptable, located at Building 962.

3.6.2 Disposal of Rubbish and Debris

Rubbish and debris shall be taken off-base for disposal, unless specifically directed otherwise below:

Metals shall be taken to the DRMO disposal area at Lot 203, as specified.

CATEGORY	CONSTRUCTION DEBRIS DISPOSAL - BASE SANITARY LANDFILL EXAMPLE/GENERAL INFORMATION FOR DEPOSIT IN THE LANDFILL
Recyclable Cardboard	Breakdown corrugated cardboard boxes and deliver to the Base Recycling Center located at Building 982. If base personnel rejects the cardboard, take cardboard for off-base disposal.
Recyclable Wood Pallets	Deliver usable pallets to the Base Recycling Center located at Building 982. If base personnel rejects the pellets, take pallets for off-base disposal.
Untreated Wood	Deliver lumber, trees, stumps, limbs, tops, tops, and shrubs to the landfill properly separated and separate from any other items, and place in locations as designated by the landfill operator.
Organic Matter	Deliver leaves, pine straw, grass clippings, and shrub clippings to the landfill separated from any other items, and place in locations as designated by the landfill operator. No bags or containers are allowed.
Asphalt Pavement	Remove pavement from Government property and deliver to an asphalt recycling establishment. Provide a record of the total tons of asphalt recycled and the corporate name and location of the recycling establishment receiving the removed asphalt.
*****	Weigh each and every vehicle delivering debris upon entrance and exit. Cover debris.
Asbestos	Refer to Section 02 82 16 or 02 82 17 or 02 82 18.00.
Lead Based Paint Materials	Refer to Section 02 82 33.13.

CATEGORY	CONSTRUCTION DEBRIS DISPOSAL - BASE SANITARY LANDFILL EXAMPLE/GENERAL INFORMATION FOR DEPOSIT IN THE LANDFILL
Metals	Metals will not be accepted at the landfill. Remove metals from each and every category before delivery to landfill. (Example: Remove hardware from doors and windows.) Dispose of metal construction debris at Defense Reutilization Maintenance Office (DRMO). Aluminum, brass, copper, lead, other metal, electrical wiring, cable (cut in 3 foot or less sections)
Construction Material	Construction material should be managed and placed in a designated area. Area shall be kept clean of debris and all material removed at the end of the project.
Solid Waste	Separate each category of solid waste to enhance recycling.
Hazardous Material	This project involves demolition, renovation/repair and/or construction activities; therefore, hazardous material (such as paints, solvents, thinners, adhesives, etc) may be used during the execution of this project. The contractor will be required to appropriately manage the hazardous material and provide secondary containment.
Solid Waste Report	All solid waste generated and recycled will be weighed. Contractor will report the amount of solid wasted disposed and recycled at the end of the project to EMD's Solid Waste Manager or the Pollution Prevention Manager via the OICC. Tonnage information for all materials delivered to the Base Landfill is available at the Landfill Office. Submit a written request to the Landfill Manager, specifying the desired information.
Recycling of Construction Debris	Recyclable material (ex. Scrap metal/aluminum/brass/copper/lead, and other metal) may be recycled through Defense Utilization Maintenance Office) DRMO using a 1348-1a with the following information

CATEGORY	CONSTRUCTION DEBRIS DISPOSAL - BASE SANITARY LANDFILL EXAMPLE/GENERAL INFORMATION FOR DEPOSIT IN THE LANDFILL
	(Proceeds for the sale of recyclable material are to go to the Qualified Recycling financial account - 17F3875 27RM 00767001 0 000027 3c 000000 06700198004). For additional information contact the Base Recycling Coordinator 910-451-4214.
Electrical Equipment	Before demolition or removal of electrical equipment from the Base - Contractor shall contact Base High Voltage Shop Supervisor at (910) 451-2790, to allow for first right of refusal of electrical equipment such as: ATS, transformers, and generators. Electrical equipment will not be accepted at landfill.

3.6.3 Disposal Off-Base

a. Provide 24-hour advance written notice to the Contracting Office of Contractor's intention to dispose of off base.

b. Disposal at sites or landfills not holding a valid State of North Carolina permit is specifically prohibited. The prohibition also applies to sites where a permit may have been applied for but not yet obtained.

c. Off-base disposal of construction debris outside the parameters of this paragraph at site without State permits and/or not in accordance with regulatory requirements shall require the Contractor at his own expense to remove, transport and relocate the debris to a State approved site. The Contractor shall also be required to pay any fines, penalties, or fees related to the illegal disposal of construction debris

3.7 CONTROL AND DISPOSAL OF HAZARDOUS WASTE

3.7.1 Hazardous Waste Generation

Handle generated hazardous waste in accordance with 40 CFR 262.

3.7.2 Hazardous Waste Disposal

Dispose of hazardous waste in accordance with Federal, State, and local regulations, especially 40 CFR 263, 40 CFR 264, and 40 CFR 265. Removal of hazardous waste from Government property shall not occur without prior notification and coordination with the Contracting officer. Transport hazardous waste by a permitted, licensed, or registered hazardous waste transported to a TSD facility. Hazardous waste shall be properly identified, packaged, and labeled in accordance with 49 CFR 172. Provide completed manifest for hazardous waste disposed of off-site to the Contracting Officer within 7 days of disposal. Hazardous waste shall not be brought onto the station.

3.7.3 Hazardous Waste Storage

Store hazardous waste in containers in accordance with 49 CFR 178. Identify hazardous waste in accordance with 40 CFR 261 and 40 CFR 262. Identify hazardous waste generated within the confines of the station by the station's EPA generator identification number.

3.7.4 Spills of Oil and Hazardous Materials

Take precautions to prevent spills of oil and hazardous material. In the event of a spill, immediately notify the Contracting Officer. Spill response shall be in accordance with 40 CFR 300 and applicable State regulations.

3.7.5 Lead-Acid Batteries

Dispose of lead-acid batteries that are not damaged or leaking at a State-approved battery recycle or at a permitted or interim status hazardous waste TSD facility. For lead-acid batteries that are leaking or have cracked casings, dispose of the electrolyte solution using one of the following alternatives:

a. An industrial waste water treatment plant, if available and approved by the Contracting Officer for disposing of lead-acid battery electrolyte.

b. Dispose of the lead-acid battery electrolyte at a permitted or interim status hazardous waste TSD facility.

The management and disposal of waste lead-acid batteries and electrolyte shall comply with requirements for management and disposal of hazardous wastes.

3.7.6 Mercury Control

Prior to starting work, remove thermostats, switches, and other components that contain mercury. Upon removal, place items containing mercury in doubled polyethylene bags, label, and turn over to the Contracting Officer for disposal.

3.7.7 Petroleum Products

Protect against spills and evaporation during fueling and lubrication of equipment and motor vehicles. Dispose of lubricants to be discarded and excess oil.

3.7.8 Ozone Depleting Substances (ODS)

Remove ODS as specified in Section 02 41 00, "Demolition."

3.8 DUST CONTROL

Keep dust down at all times, including nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not shake bags of

cement, concrete mortar, or plaster unnecessarily.

3.8.1 Abrasive Blasting

3.8.1.1 Blasting Operations

The use of silica sand is prohibited in abrasive blasting.

Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive agent, paint chips, and other debris in accordance with the requirements specified. Perform work involving removal of hazardous material in accordance with 29 CFR 1910.

3.8.1.2 Disposal Requirements

Collect dust, abrasive, paint, and other debris resulting from abrasive blasting operations and store in 55 gallon drums with watertight lids. Take a representative sample of this material, and test for EP toxicity with respect to lead, chromium, and cadmium , and _____ content. The sampling and testing shall be performed in accordance with 40 CFR 261. Handle debris resulting from the abrasive blasting operations as a hazardous material, and dispose of in accordance with 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Transport hazardous material by a transporter licensed and permitted for transportation of hazardous materials. Dispose of hazardous material in an EPA-approved and permitted facility specifically designated for hazardous waste disposal.

3.9 QUARANTINE FOR IMPORTED FIRE ANT (4/82)

Onslow, Jones, and Cartaret Counties and portions of Duplin and Craven Counties have been declared a generally infested area by the United States Department of Agriculture (USDA) for the imported fire ant. Compliance with the quarantine regulations established by this authority as set forth in USDA Publication 301.81 of 31 December 1992, is required for operations hereunder. Pertinent requirements of the quarantine for materials originating on the Camp Lejeune reservation, the Marine Corps Air Station (Helicopter), New River and the Marine Corps Air Station, Cherry Point, which are to be transported outside Onslow County or adjacent suppression areas, include the following:

a. Certification is required for the following articles and they shall not be moved from the reservation to any point outside Onslow County and adjacent designated areas unless accompanied by a valid inspection certificate issued by an Officer of the Plant Protection and Quarantine Program (PPQ) of the U.S. Department of Agriculture.

(1) Bulk soil

(2) Used mechanized soil-moving equipment. (Used mechanized soil-moving equipment is exempt if cleaned of loose noncompacted soil).

(3) Other products, articles, or means of conveyances, if it is determined by an inspector that they present a hazard of transporting spread of the imported fire ant and the person in possession thereof has been so notified.

b. Authorization for movement of equipment outside the imported fire

and regulated area shall be obtained from USDA, Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ), Box 28, Goldsboro, North Carolina, 27533-0028, Attn: Mr. William Scroggins or Mr. Frank Best, telephone (919) 735-1941. If Mr. Scroggins or Mr. Best are not available, contact Mr. Jim Kelley at (910) 815-4667, the supervisor's office in Wilmington. Requests for inspection shall be made sufficiently in advance of the date of movement to permit arrangements for the services of authorized inspectors. The equipment shall be prepared and assembled so that it may be readily inspected. Soil on or attached to equipment, supplies, and materials shall be removed by washing with water or such other means as necessary to accomplish complete removal. Resulting spoil shall be wasted as necessary and as directed.

ANNUAL REPORT OF PRODUCTS CONTAINING RECOVERED MATERIALS

Contractor shall submit data annually (By 1 December) for the following products used during the previous fiscal year (1 October - 30 September) as required by 6002 of the Solid Waste Disposal Act as ammended by Resource Conservation and Recovery Act (RCRA):

Contract Number: _____ Fiscal Year: _____

MATERIAL	UNIT	QUANTITY (CRM)	TOTAL QUANTITY
A. Insulation			
1. Loose fill	Ft3		
2. Blanket or batt	Ft2		
3. Board	Ft2		
4. Spray-in-place	m3		
5. Other			
B. Cement and Concrete	yd3		
C. Paper and Paper Products			
1. Copy Paper	Box		
2. Printing/Writing Paper	Box		
3. Corrugated and fiberboard boxes	Box		
4. Folding boxboard and cartons	Box		
5. Stationary, office papers, envelopes, and computer paper	$Amt		
6. Toilet tissue, paper towels, fasial tissue, paper napkins, doilies and industrial wipes	$Amt		
7. Brown papers and coarse papers	Box		
8. Other			

APPENDIX A

MATERIAL	DEFINITION
1. Quantity (CRM)	Quantity used containing recovered materials.
2. Total Quantity	Quantity used containing recovered materials plus quantity used not containing recovered materials.
3. Unit	Ft3 (cubic feet), Ft2 (square feet), m3 (cubic meters), yd3 (cubic yards), box (number of boxes used), $ Amt (dollar value of material used)
4. Loose-Fill Insulation	Includes, but is not limited to..."cellulose fiber, mineral fibers (fiberglass and rock wool), vermiculite, and perlite.
5. Blanket or Batt Insulation	Includes, but is not limited to... "mineral fibers (fiberglass and rock wool)."
6. Board Insulation	This category refers to sheathing, roof decking, and wood panel insulation. It includes, but is not limited to... "cellulose fiber fiberboard, perlite composite board, polyurethane, polyisocyanurate, polystyrene, phenolics, and composites."
7. Spray-in-place Insulation	Includes, but is not limited to... "foam-in-place polyurethane and polyisocyanurate, and spray-on cellulose."
8. Cement or Concrete Containing Recovered Materials, Cement, or Concrete Containing Fly Ash	
9. Copy Paper	This item refers to... "any grade of paper suitable for copying by the xerographic method."
10. Printing & Writing Paper	This item refers to... "paper designed for printing, other than newsprint, such as offset or book paper," and... "paper suitable for pen and ink, pencil, typewriter or printing."

APPENDIX A

MATERIAL	DEFINITION
11. Corrugated & Fiberboard Boxes	Corrugated boxes refer to... "boxes made of corrugated paperboard, which, in turn, is made from a fluted corrugating medium pasted to two flat sheets of paperboard (linerboard)." Fiber or fiberboard boxes refer to... "boxes made from containerboard, either solid fiber or corrugated paperboard (general term); or boxes made from solid paperboard of the same material throughout."
12. Folding Boxes and Cartons	This item refers to... "a paperboard suitable for the manufacture of folding cartons."
13. Stationery, Office Papers, Envelopes, and Manifold Business Forms	This item is considered self-explanatory, however, if questions arise refer to 40 CFR 250.4 for definitions of any of these items.
14. Toilet Tissue, Paper Towels, Facial Tissue, Paper Napkins, Doilies, and Industrial Wipes	This item is considered self-explanatory, however, if questions arise refer to 40 CFR 250.4 for definitions of any of these items.
15. Brown Papers, and Coarse Papers	Brown papers refer to... "papers usually made from unbleached kraft pulp and used for bags, sacks, wrapping paper, and so forth." Coarse papers refer to... "papers used for industrial purposes, as distinguished from those used for cultural or sanitary purposes."
16. Other	Any other type of paper not included in any of the above categories.

APPENDIX A

-- End of Section --

CAMP LEJEUNE SANITARY LANDFILL
INFORMATION SHEET
No Personal Property/Off Base Trash Accepted

General Trash

The following items may be mixed together and brought to the landfill in the same load:

Roofing Shingles (Non-Asbestos)
Insulation (Non-Asbestos)
Glass (other than bottles)
Sheet Rock (Wall Board)
Particle Board/Composition Board /OSB (re-manufactured wood products used in construction and furniture in lieu of ply-board)
Laminated/Formica covered wood products (counter tops, ect)
Hollow core interior doors
Floor tile (Non-Asbestos)
Porcelain & Ceramic products (toilets, sinks ect)
Fiber glass
PVC pipe (cut in 10' or less lengths)
Ceiling tile

Wood products

The following wood products can be mixed together and brought to the landfill in the same load:

Scrap lumber (painted and unpainted)
Embark and packing boxes (must be broken down) Broken Untreated Pallets

The following wood products must be delivered in separate loads

Trees, limbs and shrubs (cut in 10' or less lengths and free of as much dirt as possible)
Serviceable Pallets
Broken Treated Pallets
Salt treated wood
Creosote treated wood
Ammunition Crates
Wood Furniture units (must have a 1348 with Base Property and DRMO Stamps downgrading it to SCAP or be specified in the Contract)

Landfill Hours Operating 0730-1530
Mon-Thur 0730-1200 Fri

Lead Base Painted Wood Products

must be delivered to the landfill cut in less than eight foot lengths, wrapped in 6 mil plastic and sealed. Not accepted after 1400 Mon-Thur.

Asbestos (all types)

Accepted by Appointment Only
Asbestos must be double wrapped in 6 mil plastic, sealed with duct tape and labeled prior to delivery. Must be delivered before 1000 Mon-Thur.
Call Landfill Manager for appointment @ 451-2946.
Please provide manifest at time of delivery.

Organic Products

Leaves, pine straw, grass and shrub clippings must be delivered separate from other items. No bags or containers allowed. No twigs or limbs over two inches in diameter or over 6 ft in length accepted with Organic Products.

Soil

NON-CONTAMINATED soil accepted

Concrete Products

Concrete, block, brick, asphalt, concrete culverts, and mortar products must be delivered separate from other items. All wire and rebar must be cut off flush with exposed surfaces.

Recyclable Products

The following Recyclable Products Must be separated and dropped off at a recycling drop-off point or the Recycling Center: Plastic Containers, Glass bottles, Aluminum cans & foil, Cardboard, White paper, Shredded paper, Vinyl siding, Steel Cans (clean), Newspaper, Toner/ink cartridges.

CAMP LEJEUNE SANITARY LANDFILL
INFORMATION SHEET
No Personal Property/Off Base Trash Accepted

The following items <u>CANNOT</u> be accepted at the landfill:

Hazardous waste	(Contact EMD)
Liquid waste	(Contact EMD)
Metal any type	(Contact DRMO) (see Base Order 5090.17)
Paint & Paint cans	(Contact EMD)
Appliances (white gear)	(Contact EMD)
Electronics	(Contact Recycling Ctr)
Computer equipment	(Contact DRMO)
Batteries any type	(Contact EMD)
Comm wire	(Contact EMD)
Barbed wire	(Contact EMD)
Concertina wire	(Contact EMD)
Contaminated soil	(Contact EMD)
Tires	(Contact EMD)
55 Gal Drums	(Contact EMD)
Oil Filters	(Contact EMD)
Petroleum containers	(Contact EMD)
Regulated Medical waste	(Contact Navel Hospital)
PCBs or PCB containers	(Contact EMD)
Oyster Shells	(Take to Off Base collection point) (Outside T.O.P. Gate)

Items Requiring Demilitarization (Return to generating unit for demil)
Construction and Demolition debris (unless specifically stated in the contract)

<u>Other Info</u>

All furniture must be accompanied by a 1348 REJECTED by Base Property Office **AND** downgraded to Scrap by DRMO.
All other Base or USMC property must be accompanied by a 1348 downgraded to Scrap by DRMO.

Anything related to Ordinance, Ammunition or Dangerous items, including containers, tubes, and packing, must be accompanied by the ADEA Certifications and copies of the Certifier and Verifier's Appointment letters.

<u>Phone Numbers:</u>

Landfill Clerk	451-2946
Landfill Manager	451-4998
Recycling Manager	451-4214
Landfill Fax	451-9935
EMD	451-5837
EOD	451-0558
DRMO	451-8598

Marine Corps Base (MCB) Camp Lejeune

Contractor Environmental Guide

August 2008

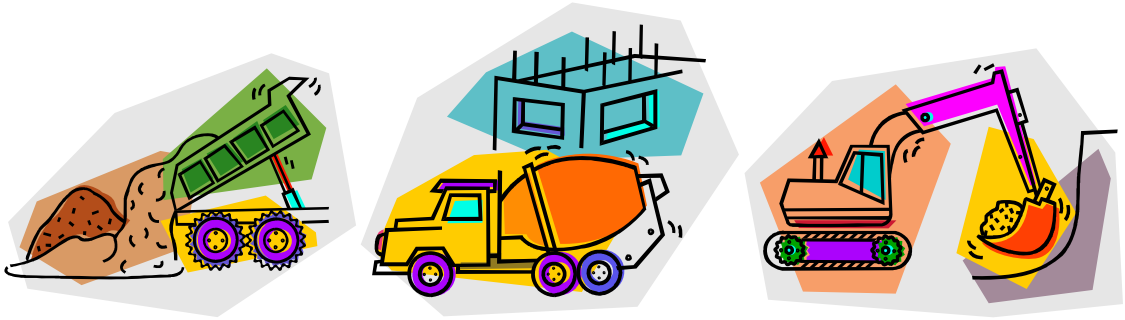


Table of Contents

1.0 CONTRACTOR ENVIRONMENTAL GUIDE OVERVIEW

The purpose of this Contractor Environmental Guide is to assist contractors working aboard Marine Corps Base (MCB) Camp Lejeune (MCBCL) and Marine Corps Air Station (MCAS) New River (MCASNR) in complying with Federal and state environmental laws and regulations, as well as Marine Corps and local Installation environmental policies. This guide is designed to answer many of the environmental questions that arise as well as provide pertinent information on environmental topics and training requirements.

This document should be used only as a *guide* to environmental issues contractors may face while working aboard MCBCL and MCASNR.

NOTE This document should be used only as a *guide* to environmental issues contractors may face while working aboard MCBCL and MCASNR. It is expected that contractors will work closely with their Resident Officer in Charge of Construction (ROICC) or Contract Representatives who will consult with the Environmental Management Division (EMD) at MCBCL and the Environmental Affairs Department (EAD) at MCASNR regarding environmental management issues, concerns, and/or questions.

NOTE This guide is designed to provide the Federal and state requirements and Marine Corps and Installation policies that pertain to MCBCL and MCASNR. It is the contractor's responsibility to know and comply with requirements and policies. Environmental personnel will assist contractors with compliance issues; however, the primary burden of regulatory identification, familiarity, and compliance lies with the contractor. This training *does not* replace any required regulatory environmental training as per contract requirements. Required environmental training should be completed *prior* to working at MCBCL or MCASNR, if required by your contract.

NOTE It is the contractor's responsibility to review the project-specific contract and specifications. Additional environmental requirements, submissions, and/or meetings not documented in this guide may be necessary.

1.1 KEY DEFINITIONS AND CONCEPTS

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact EMD or EAD if additional clarification is necessary.

The following are key definitions and concepts used throughout this guide. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

1.1.1 Key Definitions

- **Environment.** Surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation.

- **Environmental Management Division (EMD).** MCBCL's environmental division responsible for environmental issues and compliance at MCBCL and MCASNR (with the exception of hazardous waste and hazardous materials at MCASNR).

- **Environmental Affairs Department (EAD).** MCASNR's environmental department responsible for hazardous waste/hazardous material issues at MCASNR.

1.1.2 Key Concepts

- **Comprehensive Environmental Training and Education Program (CETEP).** The Marine Corps training program designed to ensure that high-quality, efficient, and effective environmental training, education, and information are provided at all levels of the Marine Corps.

- **Environmental Management System (EMS).** The part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing, and maintaining the Environmental Policy.

- **EMS Training.** Instruction that is designed to ensure that military and civilian personnel, including contractors and vendors, become familiar with the Installation's EMS and how it functions.

- **General Environmental Awareness Training.** Instruction that is designed to ensure that military and civilian personnel, including contractors and vendors, become familiar with the local environmental policies and programs for regulatory compliance, natural resource conservation, pollution prevention, and environmental protection.

- **Installation.** Throughout this document, Installation refers to all MCBCL property, including MCASNR and all outlying fields associated with MCBCL.

1.2 INSTALLATION BACKGROUND

MCB Camp Lejeune was established in 1941 in Onslow County along the southern coast of North Carolina. MCBCL is located just north of MCAS New River. MCBCL encompasses more than 153,000 acres, consisting of 26,000 acres of water and 127,000 acres of land.

The primary function of MCBCL is national defense, providing a home base for the II Marine Expeditionary Force (MEF), 2d Marine Division, 2d Marine Logistics Group, and other combat units and support commands. MCBCL's mission is to maintain combat ready units for expeditionary deployment. MCBCL maintains and utilizes supply warehouses;

maintenance shops; hazardous material and hazardous waste storage; bulk fuel storage and transfer facilities; fleet parking; housing areas; recreational areas; two golf courses; and a marina. Additionally, MCBCL is a self-sufficient Base, with its own steam-generating station, wastewater treatment plant, drinking water wells, drinking water treatment plants, and landfill.

MCASNR is the principal U.S. Marine Corps (USMC) helicopter operating location on the East Coast. The Air Station supports aircrew training in the H-53 helicopter. It is also the evaluation and prospective beddown site for the V-22 Osprey. The mission of MCASNR is to provide the necessary support for its tenant units, Marine Aircraft Group 26 (MAG-26) and MAG-29.

1.2.1 Environmental Management Division (EMD) and Environmental Affairs Department (EAD)

MCBCL's EMD, located within the Installation and Environment Department, is responsible for all natural resource and environmental matters aboard the Installation (with the exception of hazardous waste/hazardous material issues at MCASNR). EMD works closely with activities at MCBCL, educating and training personnel to comply with environmental laws while accomplishing the military mission.

The Environmental Affairs Department (EAD) is located at MCASNR. EAD and EMD work closely together. MCBCL and MCASNR participate together in one Environmental Management System (EMS).

1.2.2 Expectations

As contractors aboard the Installation, your commitment to strict compliance with environmental laws and regulations will assist the Installation in providing the best possible training facilities for today's Marines and Sailors while honoring our environmental responsibilities and objectives. Violation of environmental laws can result in severe civil or criminal penalties and fines.

1.3 OVERVIEW OF REQUIREMENTS

1.3.1 Contractor Environmental Guide

The following information is contained in the guide:

- MCBCL Contractor Environmental Guide
    - EMS overview and requirements
    - Environmental program specific requirements
- Attachment A: MCB Camp Lejeune/MCAS New River General EMS and Environmental Awareness Training for Contractors and Vendors

This guide and associated EMS and General Environmental Awareness training module is provided for review to contractors and their employees performing work aboard the Installation. Included is a summary of the EMS and environmental programs, as well as a summary of key requirements associated with the various environmental issues contractors may encounter while performing work aboard the Installation. Contractors are expected to work with their ROICC or Contract Representatives and the EMD/EAD when environmental concerns or issues arise.

This guide and associated EMS and General Environmental Awareness training module is provided for review to contractors and their employees performing work aboard MCB Camp Lejeune.

1.3.2 Environmental and EMS Training

In accordance with Department of Defense (DoD) instructions and Marine Corps Orders (MCO), MCBCL and MCASNR have implemented Comprehensive Environmental Training and Education Programs (CETEP). The goal of CETEP is to ensure that appropriate environmental instruction and related information are provided to all levels of the Marine Corps in the most effective and efficient manner to achieve full compliance with all applicable environmental training requirements. A major component of the CETEP is to provide general environmental awareness training to all individuals associated with the Installation, including contractors.

In addition to CETEP requirements, the Installation has implemented an Installation-wide Environmental Management System. The EMS highlights the fact that the authority and principal responsibility for controlling environmental impacts belong to those commands, units, offices, and personnel (including contractors) whose activities have the potential to impact the environment.

All contractors should provide both EMS and General Environmental Awareness training to their employees. This guide, along with the training materials in Attachment A, satisfy these training requirements. The

All contractors are provided both EMS and General Environmental Awareness training materials in this handbook to utilize in training their employees.

training module can also be accessed at the MCBCL EMD website at: http://www.lejeune.usmc.mil/emd/ under "General EMS and Environmental Awareness Training for Contractors and Vendors."

As such, contractors working aboard the Installation will do the following:

- Fulfill job responsibilities in compliance with environmental regulations and in conformance with EMS requirements.
- Complete all applicable environmental training and maintain associated records as per contract requirements.
- Review EMS and General Environmental Awareness training, and be aware of and understand the Environmental Policy.
- Contact their ROICC or Contract Representative immediately regarding environmental and/or EMS issues.

1.4 POINTS OF CONTACT

Table 1-1 lists the EMD Branches and their respective phone numbers. Contact your ROICC or Contract Representative, who may refer you to an EMD POC for environmental and EMS-related questions and/or concerns.

Table 1-1. EMD Points of Contact, 0730 to 1630 M–F

Branch/Program Area	Phone Number
MARINE CORPS BASE, CAMP LEJEUNE	
Environmental Management Division (EMD), I&E Dept	(910) 451-5003
Environmental Compliance Branch, EMD	(910) 451-5837
Hazardous Waste/Hazardous Material (HW/HM) Program	(910) 451-1482
Base HazMart	(910) 451-1482
Pollution Abatement System Program	(910) 451-1482
Environmental Quality Branch (Air Quality, Water Quality, Solid Waste, Permitting)	(910) 451-5068
Environmental Conservation Branch (Natural Resources, Cultural Resources)	(910) 451-5063
Conservation Law Enforcement	(910) 451-5226
MARINE CORPS AIR STATION, NEW RIVER	
Environmental Affairs Division (HW/HM issues aboard MCASNR)	(910) 449-5997

In the case of an environmental emergency, contact the appropriate party, as well as your ROICC or Contract Representative, as outlined in Table 1-2. Additional emergency response procedures are provided in Section 3.0 of this guide.

Table 1-2. Environmental Emergency Contacts

If you spill:	Call:
Hazardous waste	**911**
Unknown materials	**911**
Hazardous materials	**911**
Petroleum, oil, and lubricants (POL) and/or nonpetroleum oils (cooking oils and greases)	**911**

2.0 ENVIRONMENTAL MANAGEMENT SYSTEM

The Installation jointly operates an Environmental Management System (EMS). An EMS is a systematic way of continually implementing environmental requirements and evaluating performance. The EMS is founded on the principles of MCB Camp Lejeune and MCAS New River's Environmental Policy, which is endorsed by their respective Commanding Officers (COs). Three key principles of the Environmental Policy are to comply with relevant environmental laws and regulations, prevent pollution, and continually improve our EMS.

Three key principles of the Environmental Policy are to comply with relevant environmental laws and regulations, prevent pollution, and continually improve our EMS.

The purpose of the EMS is to sustain and enhance mission readiness and access to training areas through effective and efficient environmental management. The EMS highlights the fact that the authority and principal responsibility for controlling environmental impacts belong to those commands, units, offices, and personnel (including contractors and vendors) whose activities have the potential to impact the environment.

2.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with environmental management systems. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact EMD if additional clarification is necessary.

2.1.1 Key Definitions

- **Environment.** Surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation.

- **Environmental Aspect.** A characteristic of a practice that can cause, in normal operation or upset mode, an impact to an environmental or other resource. Each practice may have several aspects.

- **Environmental Impact.** An effect of a practice's aspect on an environmental or other resource. Each practice may have several impacts.

- **Environmental Resources.** Sensitive environmental receptors (e.g., air, water, natural resources) or cultural or historic assets at the Installation, in the surrounding community, within the ecosystem or beyond, that can be impacted by the operation of practices.

- **Practice.** A unit process that supports a military mission and can impact environmental resources. (It is the ability to impact an environmental resource that is key to defining a practice. However, practices may also impact other resources.)

- **Practice Owner.** Person(s) responsible for control of practices. EMS procedures use the term *practice owner* when assignment of more specific responsibilities is left to the owning organizations.

2.1.2 Key Concepts

- **Environmental Management System (EMS).** The part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing, and maintaining the Environmental Policy.

- **Environmental Policy.** Statement by the organization of its intentions and principles in relation to the overall environmental performance, which provides a framework for action and for the setting of environmental objectives and targets.

2.2 OVERVIEW OF REQUIREMENTS

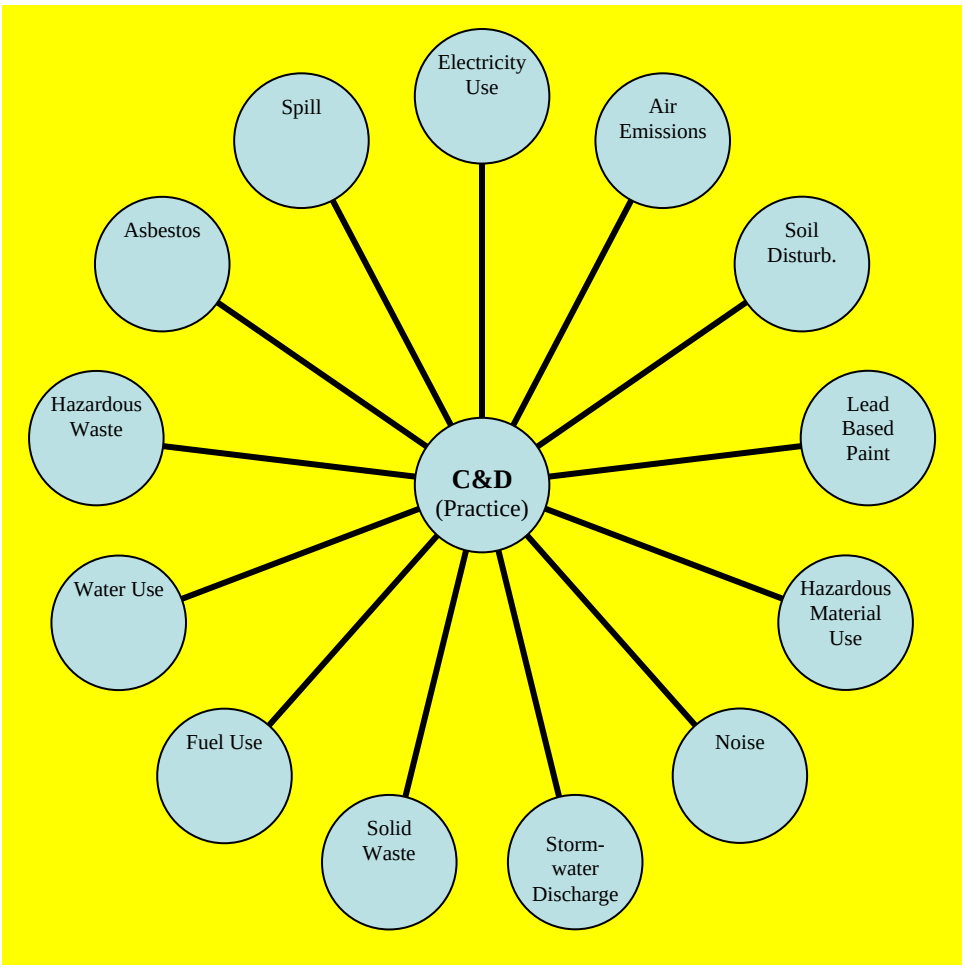
Contractors must be aware of, and adhere to, all regulations and requirements concerning EMS, including the following:

- **Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management.** Requires implementation of an EMS at all appropriate organizational levels.

2.3 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

An EMS is a systematic way of continually implementing environmental requirements and evaluating performance. The foundation of the Installation's EMS is based on the activities, or practices, conducted at the installation. One "systematic" component of the EMS is identifying all practices, or actions, executed aboard the Installation that have potential environmental aspects and impacts. Each practice at the installation, such as construction/demolition, wastewater treatment, or groundskeeping, has one or many environmental aspects. An aspect of a practice is a characteristic that can cause an impact to an environmental or other resource, such as water use. These environmental aspects can then result in an impact (e.g., depletion of natural resources) on an environmental or other resource. This relationship between practices and aspects for the practice of construction and demolition (C&D) activities is illustrated in the following simplified figure:

It is expected that contractors understand that the activities performed on base can interact with the environment and have the potential to impact the environment.



2.4 EMS RESPONSIBILITIES

It is expected that contractors understand that the activities (e.g., practices) performed on Installation can interact with the environment (e.g., environmental aspects) and have the potential to impact the environment. Therefore, it is expected that contractors will do the following:

- Review the Contractor Environmental Guide.
- Be aware of the Environmental Policy.
- Conduct activities in a manner to avoid and/or minimize impacts to the environment by complying with all applicable Federal, state, and local environmental regulations and Base Orders.
- Be familiar with spill procedures.
- Report all environmental emergencies and spills.

- Report any environmental problems or concerns promptly and notify the ROICC or Contract Representative.

- Respond to data collection efforts upon request.

2.5 CONTRACTOR ENVIRONMENTAL GUIDE AND EMS

The Contractor Environmental Guide comprises sections that are categorized based on the type of environmental requirements routinely encountered by contractors at the Installation. The following matrix relates the practices that contractors generally execute aboard the Installation to the contents of this guide. The matrix is provided to assist contractors in narrowing down specific requirements that may apply to on-site activities.

MCB CAMP LEJEUNE PRACTICES	Env. Emergency Response/ Spill Response, Section 3.0	HM/HW, Section 4.0	Unforeseen Site Conditions, Section 5.0	Asbestos, Section 6.0	Lead Based Paint, Section 7.0	Stormwater, Section 8.0	Solid Waste, Recycling, and P2, Section 9.0	Training, Section 10.0	Cultural Resources, Section 11.0	Permitting, Section 12.0	Air Quality, Section 13.0	Natural Resources, Section 14.0
Battery Replacement	Applicable To All Practices Conducted Aboard MCB Camp Lejeune		Applicable To All Practices Conducted Aboard MCB Camp Lejeune				●	Applicable To All Practices Conducted Aboard MCB Camp Lejeune				
Building Maintenance–General		●		●			●					
Building Operation–General		●					●					
Catch Basin Cleaning						●						
Construction/Demolition				●	●	●	●		●	●		●
Controlled Burn Operations											●	●
Degreasing		●									●	
Engine Operation and Maintenance		●									●	
Equipment Calibration		●										
Equipment Disposal							●					
Equipment Operation and Maintenance		●		●								
Erosion Control						●				●		●
Fuel Storage–Containers		●				●						
Fueling		●										
Grinding												
HM Storage		●			●	●						
HM Transportation		●			●							
HW Generation		●					●			●		
HW Satellite Accumulation Area		●								●		
Land Clearing						●	●		●	●		●
Landscaping						●						
Material Storage Handling		●					●					
Mowing						●						
Outfall Cleaning						●						
Packaging/Unpackaging							●					
Paint Removal					●						●	
Painting		●									●	
Painting Preparation		●										
Parts Replacement				●								
PCB Disposal		●										
Pesticide/Herbicide Application		●								●		
Range Residue Clearance						●				●		

MCB Camp Lejeune Practices	Emergency Response/ Spill Response, Chapter 3.0	HM/HW, Chapter 4.0	Unforeseen Site Conditions, Chapter 5.0	Asbestos, Chapter 6.0	Lead Based Paint, Chapter 7.0	Stormwater, Chapter 8.0	Recycling and Pollution Prevention, Chapter 9.0	Training, Chapter 10.0	Cultural Resources, Chapter 11.0	Permitting, Chapter 12.0	Air Quality, Chapter 13.0	Natural Resources, Chapter 14.0
Refrigerant Replacement	Applicable To All Practices Conducted Aboard MCB Camp Lejeune	●	Applicable To All Practices Conducted Aboard MCB Camp Lejeune					Applicable To All Practices Conducted Aboard MCB Camp Lejeune			●	
Riparian Buffer Maintenance						●						●
Rock Crushing Operations							●			●		
Runoff Sedimentation Basins						●						
Sediment Traps						●						
Soil Excavation/Grading						●			●			●
Solid Waste Recycling Collection/Transportation							●			●		
Storage Tank Cleaning and Maintenance		●								●		
Stormwater Collection/Conveyance System						●						
Stormwater Engineering Controls Operation and Maintenance						●				●		
Stump/Brush Removal						●	●		●			●
Vehicle Operation							●					
Vehicle Parking						●						
Vehicle/Equipment Fluid Change		●										

3.0 ENVIRONMENTAL EMERGENCY RESPONSE/SPILL RESPONSE

The purpose of emergency planning is to control, contain, and remove releases of materials while minimizing impacts to human health and the environment. Contractors operating aboard the Installation must be aware of, and adhere to, environmental emergency response procedures and notification requirements to minimize detrimental effects from inadvertent releases.

For procedures relating to emergencies caused by unforeseen site conditions, please refer to Section 5.0 in this guide. For other types of non-environmental emergencies, always call 911.

3.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with environmental emergency response and spill response requirements. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact EMD if additional clarification is necessary.

3.1.1 Key Definitions

- **Berm.** A mound used to prevent the spread of a contaminated area.
- **Non-Petroleum Oil.** Oil products that may include, but are not limited to, synthetic oils such as silicone fluids and tung oils, wood-derivative oils such as resin/rosin oils, animal fats and oil, and edible and inedible seed oils from plants.
- **POL.** Petroleum, Oil, and Lubricant products that may include, but are not limited to, any petroleum-based products such as gasoline, diesel fuel, jet fuel, engine oil, gear oil, lube oil, and lubricant products such as hydraulic brake fluid, automatic transmission fluid (ATF), and grease.
- **Release.** The uncontrolled loss of a hazardous material from its storage vessel, to include POLs. All releases are required to be reported to the Fire and Emergency Services Division. Releases of POLs that occur within an enclosed and contained maintenance facility are not subject to this reporting requirement provided they do not have the potential to impact the environment.

3.1.2 Key Concepts

- **Environmental Emergency Response Contacts:**

If you spill:	Call:	Follow-up:
Hazardous waste	**911**	Spill Report
Unknown materials	**911**	Spill Report
Hazardous materials	**911**	Spill Report

- **Spill Follow-Up.** Contractors have containment and cleanup responsibilities following a spill.

3.1.3 Environmental Management System

All practices associated with Emergency Response/Spill Response are listed in Section 2 of this Handbook. The following is a list of potential impacts associated with these practices.

- Air Quality Degradation
- Community Relations/Public Perception Impact
- Depletion of Landfill Space
- Depletion of Resources
- Electricity Consumption
- Fuel Consumption
- Groundwater Quality Degradation
- Historic/Cultural Resource Disturbance
- Other Natural Resource Disturbance
- Personnel Exposure
- Potable Water Quality Degradation
- Real Property/Private Property Damage
- Soil Compaction
- Soil Erosion
- Soil Quality Degradation
- Surface Water Quality Degradation
- Water Consumption
- Wetlands Disturbance
- Wildlife Species/Habitat Disturbance

3.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding emergency response and spill procedures, including the following:

- **Clean Air Act (CAA) of 1970, Section 112r.** Specifies emergency planning where potential exists for catastrophic release of hazardous air pollutants.
- **Clean Water Act (CWA) of 1972.** Establishes the basic structure for regulating discharges of pollutants into the Waters of the United States.
- **Comprehensive Environmental Response, Compensation, and Liability (CERCLA) Act of 1980.** Authorizes federal response to any release or threatened release of hazardous substance into the environment. This act defines hazardous substances (HS) by reference to substances that are listed or designated under other environmental statutes.
- **Emergency Planning and Community Right-to-Know Act of 1986, Section 304.** Establishes requirements for the reporting of a release to ensure a quick response by local emergency responders. Notification requirements apply to two chemical lists: the Extremely Hazardous Substances (EHS) list and CERCLA HS list. The "List of Lists" provides comprehensive identification of EHSs and HSs.
- **NC General Statute Chapter 143, Article 21A – Oil Pollution and Hazardous Substances Control.** Prohibits pollution by oil, oil products, oil by-products, and other hazardous substances into the land and the waters over which the State has jurisdiction. The statute establishes specific requirements for reporting a release to the State and supports and complements applicable provisions of the Federal Water Pollution Control Act.
- **Oil Pollution Act (OPA) of 1990.** Addresses oil storage at facilities and emphasizes preparedness and response activities. This act prohibits the harmful discharge of oil and hazardous substances into Waters of the United States.
- **Resource Conservation and Recovery Act of 1976 Subtitle C.** Establishes a system for controlling hazardous waste from the time it is generated, transported, treated, stored, and/or disposed of, or from "cradle to grave."

3.3 Spill Notification

The Installation Integrated Contingency Plan (ICP) provides general information for any type of response actions needed for spills aboard the Installation. Contractors must develop a Unit Level Contingency Plan that addresses spill response for their specific sites and potential spill types (e.g., chemical; sewer; POL; and non-petroleum oils). This plan must be maintained onsite and be available for review upon request.

Contractors must develop a Unit Level Contingency Plan that addresses spill response for their specific sites and potential spill types.

In the event of a spill, contact your ROICC or Contract Representative after contacting emergency response. They will contact EMD to obtain a spill report form. Return the completed form to EMD (Fax # (910) 451-3471) and to your ROICC or Contract Representative. A copy of the spill reporting form is included as Attachment 3-1. The following information must be provided when reporting a spill to 911:

- Your name and phone number
- Location of spill (building. number, street)
- Number and type of injuries, if any
- Type and amount of spilled material
- Source of the spill (container, vehicle, etc.)
- Action being taken, if any, to control the spill
- Estimated time of spill

Do not wait to report a spill if all of the required information is not immediately available.

3.4 Follow-Up

Should surface runoff be contaminated, the contractor will, under the advisement of the Fire and Emergency Services Division or EMD, construct a temporary berm or containment area. Contaminated surface water will be removed in accordance with all safety and environmental requirements for the Installation. The Resource Conservation and Recovery Section (RCRS) within EMD ((910) 451-1482) will be notified and will provide concurrence for temporary containment areas and removal of contaminated runoff.

If solid or hazardous waste was generated as the result of a spill, refer to Sections 4.0 and 9.0 of this guide for disposal requirements.

Attachment 3-1

Spill Reporting Form

** For EMD Personnel Only.
Fill out all the blanks except for #18.

SPILL REPORTING FORM

CALL RECEIVED BY: _____ RESPONDED BY: _____

SUBJ: _____

1. DATE: _____ TIME: _____

2. SOURCE: _____

(Include Serial Number of equipment if available).

3. LOCATION BUILDING: _____

4. Did Fire Dept. Respond? _____ Name of Responder: _____

5. UNIT/AGENCY: _____ POC: _____

6. ESTIMATED AMOUNT: _____ GALLONS -- QUARTS -- PINTS (Circle One)

7. TYPE OF SUBSTANCE: _____

8. SAMPLES TAKEN: _____

9. SLICK DESCRIPTION: (NONE) **OR _____**

10. ACTION TAKEN: _____

_____

_____

11. ON SCENE WEATHER: _____

12. OIL SPILL MOVEMENT: (NONE) **OR _____**

13. DAMAGE: (NONE) **OR _____**

14. POTENTIAL DANGER: (NONE) **OR _____**

15. CAUSE OF SPILL: _____

_____

_____

16. PARTIES PERFORMING SPILL REMOVAL: _____

_____

17. ASSISTANCE REQUIRED: NO ADDITIONAL **OR _____**

_____

**** 18. TELEPHONE REPORT WAS MADE TO NRC—TIME _____ DATE _____ CONFIRMATION NUMBER IS _____. TELEPHONE REPORT WAS MADE TO NC DIVISION OF EMERGENCY—TIME _____ DATE _____, POC IS _____.**

POINT OF CONTACT IS MR JOHN HAMILTON, ENVIRONMENTAL COMPLIANCE BRANCH, ENVIRONMENTAL MANAGEMENT DIVISION, INSTALLATION AND ENVIRONMENT DEPARTMENT, AT (910) 451-1482.

4.0 HAZARDOUS MATERIALS/HAZARDOUS WASTE MANAGEMENT

All persons on a Marine Corps installation are subject to compliance with Federal and state regulations and permit conditions addressing the proper management of both hazardous materials and hazardous waste. Mishandling these wastes and materials may result in violation notices, fines, and/or penalties. The U.S. Environmental Protection Agency (USEPA) regulates hazardous wastes through the Resource Conservation and Recovery Act (RCRA), which provides specific regulatory definitions for hazardous waste and its management. RCRA governs all hazardous waste from the point of generation to the point of final disposal. This includes hazardous waste generated by contractors aboard the Installation. Hazardous materials, including those used by contractors aboard the Installation, are regulated by the Emergency Planning and Community Right-to-Know Act (EPCRA). Additionally, the North Carolina Department of Environment and Natural Resources (NCDENR) has issued more stringent rules and regulations governing hazardous materials and hazardous waste management that also apply to contractors.

4.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with hazardous materials, hazardous wastes, and their management. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

4.1.1 Key Definitions

- **Hazardous Material (HM).** A chemical compound, or combination of compounds, posing or capable of posing a significant risk to public health, safety, or the environment as a result of its quantity, concentration, or physical/chemical/infectious properties.

- **Hazardous Waste (HW).** A solid waste, or combination of solid wastes, which because of quantity, concentration, or physical, chemical, or infectious characteristics may:

- Cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness, or

- Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

- **Manifest.** A document that allows all parties involved in hazardous waste management (e.g., generators, transporters, disposal facilities, USEPA, state agencies) to track the movement of hazardous waste from the point of generation to the point of ultimate treatment, storage, or disposal.

- **Material Safety Data Sheet (MSDS).** A document that provides information about (1) the potential health effects of exposure to chemicals or other potentially dangerous substances and (2) safe working procedures for users to adhere to when handling that chemical or substance.

- **Non–RCRA-Regulated Waste.** A waste that is not regulated or is exempt from regulation under RCRA hazardous waste requirements but has other regulatory requirements for proper management.

- **Satellite Accumulation Area (SAA).** A HW generation point at which waste may be accumulated until the HW storage container is full. A filled container must be transferred within 72 hours to an approved 90-day site or long-term HW storage facility. An EMD authorization for an SAA must be obtained and posted at the site. EMD authorization will establish individual limits for each SAA. No SAA authorizations will exceed 55 gallons of HW or 1 quart of acutely HW. Per Installation policy, storage of HW in a SAA should not exceed 365 days even if the container is not full.

- **Universal Waste (UW).** Universal waste regulations streamline hazardous waste management standards for batteries, pesticides, mercury-containing equipment, and fluorescent lamps. The regulations govern the collection and management of these widely generated wastes, thus facilitating environmentally sound collection and proper recycling or treatment. In North Carolina, batteries,

thermostats, obsolete agricultural pesticides, and fluorescent lamps may be managed under the UW Rule. UW must be transferred off-site within one (1) year of the date when the material was first identified as waste.

- **Used Oil.** Any oil that has been refined from crude oil or synthetic oil and, as a result of use, storage, or handling, has become unsuitable for its original purpose due to the presence of impurities or loss of original properties. Used oil may be suitable for further use and is economically recyclable, therefore is managed as a separate category of material.

4.1.2 Key Concepts

None.

4.1.3 Environmental Management System

Practices, or activities, associated with hazardous materials and hazardous waste management includes the following:

- Building maintenance–general
- Building operation–general
- Degreasing
- Engine operation and maintenance
- Equipment calibration
- Equipment operation and maintenance
- Fuel storage–containers
- Fueling
- HM storage
- HM transportation
- HW satellite accumulation area
- Painting
- Painting preparation
- Polychlorinated biphenyl (PCB) disposal
- Pesticide/herbicide application
- Refrigerant replacement
- Storage tank cleaning and maintenance
- Vehicle/equipment fluid change

The potential impacts of these activities on the environment include depletion of the hazardous waste landfill; depletion of non-renewable resources; and degradation of soil quality.

4.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard MCB Lejeune and MCAS New River must be aware of, and adhere to, all applicable regulations and requirements regarding hazardous materials and hazardous waste, including the following:

- **Base Order (BO) 5090.9, Hazardous Material/Waste Management/Air Station Order (ASO) 5090.2, Environmental Compliance and Protection Program for MCAS New River.** Establishes procedures and general responsibilities for the disposal of hazardous material and hazardous waste under environmental permits and authorizations.

- **Emergency Planning and Community Right-to-Know Act (EPCRA).** Establishes requirements regarding emergency planning and the reporting of hazardous chemical storage and usage.

- **Resource Conservation and Recovery Act (RCRA) of 1976.** Establishes standards for generators and transporters of hazardous waste that will ensure the following: proper recordkeeping and reporting; use of manifest system; use of appropriate labels and containers; and proper management of hazardous waste transfer, storage, and disposal facilities.

- **40 CFR Subchapter I (Parts 260–299), Solid Wastes.** Federal regulations promulgated under the 1976 RCRA that regulate hazardous waste management, generators, transporters, and owners or operators of treatment, storage, or disposal facilities. North Carolina has adopted the Federal hazardous waste rules by reference.

The Installation is a large quantity generator of hazardous waste. Therefore, all hazardous waste generated aboard MCB Camp Lejeune must meet the regulatory requirements of this generator designation.

Both MCB Camp Lejeune and MCAS New River maintain Hazardous Waste Management Plans that outline the specific requirements for

managing hazardous materials and hazardous wastes each Base. This section presents key points from these documents.

The contractor is responsible for ensuring that any used hazardous materials generated during work aboard MCB Camp Lejeune are properly managed and turned in weekly on Wednesday from 1300 - 1500 hours to the EMD Consolidation Center, Bldg. S-962 on Michael Road. For work aboard MCAS New River, hazardous materials can be turned at the Environmental Affairs Department (EAD) Hazardous Waste warehouse, Bldg AS-4225, located on Canal Street. This includes universal waste, used oil, petroleum-contaminated materials, regulated hazardous waste, and non–RCRA-regulated waste. Environmental personnel will provide oversight to verify compliance with applicable Federal and state laws governing the generation and handling of these materials.

Depending on the type of project, contractors may be required to submit a Hazardous Waste Management Plan to the ROICC or the Contract Representative prior to beginning work. Additionally, a Contractor Hazardous Material Inventory Log and corresponding MSDSs for all materials to be used aboard either Base during the execution of the contract may be required by the Contracting Officer. EMD/EAD will use the MSDSs to help contractors establish their Hazardous Material Storage and Satellite Accumulation Areas.

Contractors may be required to submit a Hazardous Waste Management Plan to the ROICC or the Contract Representative prior to beginning work.

4.3 HAZARDOUS MATERIALS REQUIREMENTS

If a project uses hazardous materials:

- Reduce/reuse/recycle when possible; meet contract requirements for recycling.

- Segregate incompatible materials. Consult your MSDS or EMD if you are unsure of a material's compatibility. Some **examples of incompatible materials** likely to be used by contractors at the Installation are:

    - **Corrosives** (e.g., batteries, stripping and cleaning compounds containing acids or bases) **and Flammables** (e.g., fuels, oils, paints, and adhesives);

  - **Corrosives** (e.g., batteries, stripping and cleaning compounds containing acids or bases) **and Oxidizers** (e.g., bleach); and

  - **Oxidizers** (e.g., bleach) **and Flammables** (e.g., fuels, oils).

- Keep flammable materials in flammable storage lockers.

Do not store large quantities of materials. Keep on hand only what can be used.

- Do not store large quantities of materials. Keep on hand only what can be used.

- Do not dump any hazardous material into floor drains, sinks, oil-water separators, or storm drains, or onto the ground

- Store containers that hold 55 gallons or more (including in-use electrical generators and portable equipment) in proper secondary containment. Containment must be inspected on a weekly basis; all inspections and drainage events must be documented.

- Maintain MSDSs and appropriate spill control/cleanup materials on-site at all times.

Stop work immediately if a project unearths a hazardous material (such as munitions or ordnance) and report the situation to the ROICC or Contract Representative.

- Provide HAZMAT storage and usage information for regulatory reporting to the appropriate environmental office upon request.

- Stop work immediately if a project unearths a hazardous material (such as munitions or ordnance) and report the situation to the ROICC or Contract Representative.

- Do not leave hazardous materials on-site once the contract is completed. Remove from Installation property or turn in all full, partially full, and empty hazardous material containers to the Resource Conservation and Recovery Section (RCRS) at Bldg. S-962 on Michael Road (MCBCL) or EAD at Bldg AS-4225 on Canal Street (MCASNR) upon completion of the contract.

4.4 UNIVERSAL WASTE REQUIREMENTS

NCDENR allows thermostats, obsolete agricultural pesticides, lamps, and certain types of batteries to be managed as universal waste (UW). UW has less stringent requirements for storage, transport, and collection, but must

still comply with full hazardous waste requirements for final recycling, treatment, or disposal. UW requirements are outlined in 40 CFR 273.

All UW must be properly containerized, stored, and labeled at the time the waste is first generated. Containers/areas accumulating UW must be labeled as follows:

- Words: *UNIVERSAL WASTE*.
- Content: Noun name found on the specific Hazardous Waste Profile Sheet (DRMS Form 1930) available from EMD (e.g., *batteries, fluorescent lamps, pesticides, mercury-containing equipment*).
- Accumulation Start Date (ASD): The ASD must be marked on the subject container the moment a UW item is placed into the container. Storage of UW cannot exceed 365 days.
- Number of Containers: The number of containers marked reflects the total number of containers disposed of within the current document (i.e., 1 of 1, etc.).

RCRS or EAD personnel will assist contractors in establishing each UW accumulation area. Key points to follow:

- The containers must be under the control of the contractor generating the waste and must be closed at all times except when adding waste.
- Per Installation policy, UW containers/areas must be inspected weekly using the Weekly Hazardous Waste (HW) Site Inspection Form included as Attachment 4-1 or 4-2. Written records noting discrepancies as well as corrective actions must be maintained onsite for a period of three years. Copies of inspection reports should be provided to the ROICC or Contract Representative.
- When the ASD reaches one year or when the container is full, the waste generator has 72 hours (3 days) to move the UW into the permitted storage area at Bldg. S-962 on Michael Road (MCBCL) or to Bldg AS-4225 on Canal Street (MCASNR). Coordinate with the appropriate environmental office for pickup (MCBCL – (910) 451-1482; MCASNR – (910) 449-5997/6143) when the drum is full or the contract is finished.

4.5 HAZARDOUS WASTE REQUIREMENTS

The appropriate environmental office must be notified before any hazardous waste is generated on projects managed by the ROICC or the FSC.

The appropriate environmental office must be notified before any hazardous waste is generated on projects managed by the ROICC or the Facilities Support Contracts (FSC). If you are uncertain about whether a waste meets the definition of a hazardous waste, have your ROICC or Contract Representative contact RCRS or EAD. Installation personnel must approve all regulated waste and hazardous waste storage locations.

If a project generates hazardous waste:

- Minimize generation through waste minimization and pollution prevention techniques.
- Have your ROICC or Contract Representative contact RCRS or EAD if you are unsure about how to manage a waste. Do not mix waste types (e.g., used oil rags and solvent rags).
- Have your ROICC or Contract Representative contact RCRS or EAD for turn-in procedures as wastes are generated.
- Do not dump any hazardous waste into floor drains, sinks, oil-water separators, or storm drains, or onto the ground. Do not place hazardous waste into general trash dumpsters.
- Ensure that hazardous waste drums are properly labeled and lids are secured (wrench tight).
- Ensure that SAAs are managed properly and storage limits are not exceeded; have your ROICC or Contract Representative consult with RCRS or EAD prior to creating a new SAA.

4.5.1 Storage

All hazardous waste must be properly containerized, stored, and labeled at the time the waste is first generated. Hazardous waste must be stored in containers that meet applicable specifications of the U.S. Department of Transportation (DOT). Hazardous waste labels, as required by the USEPA and the NCDENR, must contain the following information:

- Words: *HAZARDOUS WASTE*.

- Content: Noun name found on the specific Hazardous Waste Profile Sheet (DRMS Form 1930) provided by RCRS or EAD.

- Accumulation Start Date (ASD): For HW accumulated in an SAA, the ASD will be affixed once the container is filled or at the one-year anniversary, whichever comes first.

- Number of Containers: Reflects the total number of containers (i.e., 1 of 1, etc.).

Any HW generated by contractors must be stored in a SAA. RCRS or EAD will assist contractors in establishing each SAA. A summary of procedures follows:

- The generator of hazardous waste may accumulate as much as 55 gallons of a hazardous waste stream (or less than one quart of acutely hazardous waste) in a container at or near the point of generation.

- The containers must be under the control of the contractor generating the waste and must be kept closed (wrench tight) at all times except when adding waste.

- Hazardous waste containers must be inspected weekly using the Weekly Hazardous Waste (HW) Site Inspection Form included as Attachment 4-1 or 4-2. Written records noting discrepancies as well as corrective actions must be maintained for a period of three years. Copies of inspection reports should be provided to the ROICC or Contract Representative.

- The generating contractor should monitor the level of waste in the SAA container and shall coordinate turn-in to RCRS or EAD prior to it becoming full. If the SAA container should become full, the generating contractor has 72 hours (3 days) to move the hazardous waste to the permitted storage area at Bldg. S-962 on Michael Road (MCBCL) or Bldg AS-4225 on Canal Street (MCASNR). Storage of HW in a SAA should not exceed 365 days even if the container is not full.

4.5.2 Manifesting and Disposal

Disposal of hazardous waste generated by contractors must be coordinated with the Installation. Hazardous and universal waste generated aboard MCB Camp Lejeune and MCAS New River must be transported off-base by a permitted hazardous waste transporter and must include a hazardous waste manifest. These procedures must be followed:

Only personnel from EMD who have been designated in writing by the MCB Camp Lejeune Commanding Officer can sign the hazardous waste manifest.

- The MCB Camp Lejeune or MCAS New River USEPA ID number is used for disposal of all contractor-generated hazardous waste.
- Only personnel from the Installation who have been designated in writing by the Commanding Officer can sign the hazardous waste manifest. Your ROICC or Contract Representative should contact RCRS at (910) 451-1482 (MCBCL) or EAD at (910) 449-5997 (MCASNR) regarding manifesting regulated and non-regulated wastes off-site.
- Under NO circumstances can a contractor or ROICC or Contract Representative sign a hazardous waste manifest or use another USEPA ID number for wastes generated at Installation.

4.6 NON–RCRA-REGULATED WASTE REQUIREMENTS

Non–RCRA-regulated wastes include used oil and oil filters, used antifreeze, contaminated wipes, discarded electronic equipment, and batteries not managed as universal waste.

4.6.1 Used Oil and Oil Filters

Used motor oil itself is *not* regulated as a hazardous waste in North Carolina if it is recycled or burned for energy recovery. If used oil is not recycled, the generator must determine prior to disposal whether it is a hazardous waste. Used oil must be collected in drums marked “Used Oil.” If the Used Oil storage container has a volume of 55 gallons or more, it must be stored in secondary containment. Coordinate with RCRS at (910) 451-1482 (MCBCL) or EAD at (910) 449-5997 (MCASNR) for pickup when the drum is full or the contract is finished.

- Do not dump used oil into drains, sinks, or trash containers, or onto the ground.
- Do not store used oil in open buckets or drip pans, damaged or rusted containers, or containers that cannot be fully closed.
- Do not mix used oil with other waste materials.

Used oil filters are not regulated as hazardous waste in North Carolina as long as they are not mixed with listed hazardous wastes. To qualify for this exclusion, the following conditions must be met:

- Used oil filters must be gravity hot-drained by puncturing the filter anti-drain back valve or filter dome and hot draining into a "Used Oil" storage drum. "Hot-drained" means that the oil filter is drained at a temperature that approximates the temperature at which the engine operates. All used oil filters will be hot-drained for a minimum of 24 hours before turn-in to RCRS at Bldg. S-962 on Michael Road (MCBCL) or EAD at Bldg AS-4225 on Canal Street (MCASNR).
- Any incidental spillage that occurs must be cleaned up with Dry Sweep, rags, or "oil socks."
- Drained used oil filters must be collected in a container that is in good condition and is labeled with the words "Drained Used Oil Filters."
- No other waste streams should be deposited in containers collecting used oil filters for disposal.
- Drained used oil filters will be turned into RCRS at Bldg. S-962 on Michael Road on a weekly basis on Wednesday from 1300 to 1500 (MCBCL) or to EAD at Bldg AS-4225 on Canal Street (MCASNR).

4.6.2 Used Antifreeze

Used antifreeze is considered a hazardous waste because of its toxicity unless it is recycled or placed in an approved storage area. Used antifreeze will be containerized in spill proof containers and turned in at RCRS on a weekly basis at Bldg. S-962 on Michael Road, for recycling. For used

antifreeze generated aboard MCAS New River, contact EAD at (910) 449-5997 for turn-in instructions.

4.6.3 Petroleum-Contaminated Wipes/Oily Rags

Petroleum-contaminated wipes and oily rags are to be managed as non-regulated waste. Follow these procedures:

- Store oil-contaminated wipes and oily rags in metal containers because of their flammability/combustibility to protect them from the weather.
- Do not throw these non-regulated waste items into solid waste dumpsters or garbage cans.
- Turn petroleum-contaminated wipes and oily rags that are not on a red rag contract into RCRS at Bldg. S-962 on Michael Road on a weekly basis on Wednesday from 1300 to 1500 (MCBCL) hour or to EAD at Bldg AS-4225 on Canal Street (MCASNR).

4.6.4 Used Electronic Equipment

Used electronic equipment usually contains lead solder or polychlorinated biphenyl (PCB) oils (i.e., light ballast). These items will be turned in as they are generated. Have your ROICC or Contract Representative contact RCRS (MCBL) at (910) 451-1482 or EAD (MCASNR) at (910) 449-5997 for proper handling and turn-in procedures.

4.6.5 New and Used Batteries (Not Regulated as Universal Waste)

- Store compatible batteries together (i.e., lithium batteries should be stored with other lithium batteries).
- Store batteries off the ground to prevent them from coming into contact with water.
- Store lead-acid batteries away from an open flame.
- Place rechargeable batteries in plastic bags before storing them with other rechargeable batteries.
- Do not dispose of batteries unless authorized.

- Have your ROICC or Contract Representative contact RCRS at (910) 451-1482 or EAD at (910) 449-5997 for proper handling and turn-in procedures.

Attachment 4-1

Weekly Hazardous Waste (HW) Site Inspection Form
MCB Camp Lejeune

MCB Camp Lejeune Weekly Hazardous Waste (HW) Site Inspection
Universal Waste (UW)/Satellite Accumulation Area (SAA)

Bldg Number/location of HW Site: _____
Unit Evaluated: _____ Evaluation Date: _____/_____/_____
Evaluation By (Site Manager): _____ Evaluation Time: _____

QUESTION	YES	NO	Location of Discrepancy ***and*** Proposed Corrective Action
1. Is housekeeping maintained in acceptable manner?			
2. Is any HW present at site?			
3. Are HW containers properly marked?			
4. Are HW containers in serviceable condition			
5. Are container bungs, caps, openings properly secured?			
6. Is unit spill plan/activation prominently posted?			
7. Is 911 spill response sign posted?			
8. Are **"Danger-Unauthorized Personnel Keep Out"** signs posted so they may be seen from any approach?			
9. Are **"No Smoking"** signs posted?			
10. Does the site have emergency communication system or two man rule in effect? If the two man rule is implemented is there a sign with the legend "**Two Man Rule in Effect**" posted?			
11. Are properly charged fire extinguishers as well as eye wash stations present and are they inspected at least monthly?			
12. Is the post indicator valve in good operating condition and secured in the closed position, are there any structural defects such as cracked concrete?			
13. Is the proper spill response equipment readily available?			
14. Is the site designated, recognizable, and is the EMD Authorization posted within the site as to be visible to personnel placing waste into the container? (SAA site only)			
15. Are all hazardous wastes properly segregated and stored in the designated site?			
16. Are there any hazardous materials being stored in the Satellite Accumulation Area or < 90 day storage site?			

Attachment 4-2

Weekly Hazardous Waste (HW) Site Inspection Form
MCAS New River

Weekly Hazardous Waste Storage
Area Inspection Form

Squadron: _____ Inspector: _____

Date: _____ Signature: _____

Question	Yes	No	Corrective Actions or N/A
1. Is the HW container located at or near the point of generation?			
2. Is the HW container DOT approved?			
3. Is the HW container marked correctly with the words Hazardous Waste, correct noun name of contents, NSN'S and unit designator?			
4. Is the HW container closed and wrench tight when not adding to the container?			
5. If a funnel is left in place, does that funnel have a plug or ball valve to be considered closed or secured?			
6. Is the HW container in good condition? (no excessive rust or dents in critical areas, seals are in place, no bulging or collapsing and no signs of spillage or leakage)			
7. Is the Spill Contingency Plan posted and in plain view?			
8. Is the SAA Site approval letter from EAD posted at the SAA site?			
9. Is the SAA Site limited to Authorized Personnel only?			
10. Is the HW container below the proper ullage for a liquid to expand? (4 inches from the top)			
11. Are SAA HW containers moved to the 90-Day Site within 72 hours when filled to the proper ullage or weight capacity of the container?			
12. (90 Day-Site only) Are all palletized waste streams correctly marked with Hazardous Waste or Universal Waste, noun name of the waste, NSN and unit designator on the pallet or wall of the waste structure?			
13. (90 Day-Site only) Are all HW containers turned into DRMO prior to the 90th day since the ASD?			
14. Are there adequate spill response supplies readily available for use in case of spill or leakage?			
15. Is there a means of emergency communications between storage facilities and working spaces?			
16. Is the SAA site or 90 Day-Site in a good state of police?			

5.0 UNFORESEEN SITE CONDITIONS

Marine Corps Base (MCB) Camp Lejeune was placed on the U.S. Environmental Protection Agency's (USEPA's) National Priorities List (NPL) effective November 4, 1989. To ensure the protection of human health and the environment, a proactive Installation Restoration Program has been established and is in the process of assessing and remediating various sites on the Installation. Numerous investigations have been performed on the Installation to ensure that all contaminated sites have been found, but additional contaminated areas may still exist. As a contractor, it is your responsibility to notify the ROICC or Contract Representative of any unforeseen site conditions you encounter while on the Installation. It is recommended that any contractors performing intrusive activities on the Installation be properly trained in accordance with the Occupational Safety and Health Act (OSHA) standards as written in 29 CFR 1910.120(e). If intrusive activities are planned in known contaminated areas, all required environmental training should be completed *prior* to working at MCB Camp Lejeune. Copies of training records should be available upon request by federal or state regulators.

5.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with unforeseen site conditions. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

5.1.1 Key Definitions

- **National Priorities List (NPL)**. Lists the sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants.

- **Unforeseen Site Condition.** A potentially hazardous, unanticipated site condition encountered on a job site.

5.1.2 Key Concepts

- **Notification.** Contractors must notify the ROICC or Contract Representative of any unforeseen site conditions.

- **Response.** Contractors must stop working and evacuate work areas in the event unforeseen site contaminants are suspected.

5.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding unforeseen site conditions.

- **Comprehensive Environmental Response, Compensation, and Liability (CERCLA) Act of 1980 and Superfund Amendments & Reauthorization Act (SARA) of 1986.** Establishes the nation's hazardous waste site cleanup program.

5.3 UNFORESEEN SITE CONDITION PROCEDURES

5.3.1 Petroleum, Oil, and Lubricants (POL)

If you notice an odor, stop work and immediately clear the area of all personnel to a safe distance upwind of the suspected area.

The most frequent condition encountered that requires EMD assistance is the presence of a petroleum, oil, or lubricant odor while excavating. If you notice an odor, take the following action:

- Stop work.
- Immediately clear the area of all personnel to a safe distance upwind of the suspected area.
- Call the Fire and Emergency Services Division (911) immediately if personnel are affected or injured by the suspected contaminant.
- Call the Fire and Emergency Services Division to properly secure the area.
- Notify the ROICC or Contract Representative so that the EMD Spill Response Team will be contacted to determine the appropriate course of action.

Please note that while staged and awaiting sampling results and proper disposal, the contaminated soil is to be placed on and covered with plastic. [Note: Per the Resource Conservation and Recovery Act, the North Carolina Department of Environment and Natural Resources does not allow contaminated soils to be reintroduced into excavations].

5.3.2 Munitions and Ordnance

Stop work immediately if a project unearths a hazardous material (such as munitions or an ordnance item) and report the situation to the ROICC or Contract Representative.

For other emergency response procedures, please refer to Section 3.0 of this guide.

Stop work immediately if a project unearths a hazardous material (such as munitions or an ordnance item) and report the situation to the ROICC or Contract Representative.

6.0 ASBESTOS

Contractors working aboard the Installation must follow Federal and state regulations for the proper notifications and management of asbestos associated with demolition and renovation projects, as well as Installation requirements.

6.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with asbestos and its management. If you have any questions or concerns about the information in this section, please consult with the ROICC or your Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with the ROICC or your Contract Representative.

6.1.1 Key Definitions

- **Asbestos.** A group of natural minerals that separate into strong, very fine fibers that are heat resistant and extremely durable.
- **Asbestos-Containing Material (ACM).** Any material containing more than one (1) percent asbestos, per 29 CFR 1101.
- **Category I Nonfriable ACM.** Asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than one percent asbestos, per 40 CFR 61.
- **Category II Nonfriable ACM.** Any material, excluding Category I nonfriable ACM, containing more than one (1) percent asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure, per 40 CFR 61.
- **Demolition.** The removal of any load-bearing walls or structure.
- **Friable.** Any ACM that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure (may include damaged ACM that was previously identified as nonfriable), per 40 CFR 763.
- **Glove Bag.** A sealed compartment with attached inner gloves that is used for the handling of ACM.

- **Presumed Asbestos-Containing Material (PACM).** Thermal system insulation and surfacing material found in buildings constructed no later than 1980, per 29 CFR 1926.

- **Regulated Asbestos-Containing Material (RACM).** Includes friable ACM, Category I nonfriable ACM that has become friable, Category I nonfriable ACM that has been sanded, ground, cut, etc., and Category II nonfriable ACM that has a high probability of becoming crumbled, pulverized, or reduced to powder during demolition or renovation, per 40 CFR 61.

- **Renovation.** Altering a facility or its components in any way, including the stripping or removal of RACM, per 40 CFR 61.

6.1.2 Key Concepts

- **Demolition Notification**. North Carolina law requires notification for all demolitions, regardless of whether asbestos is present, 10 working days prior to starting demolition.

- **Disposal**. ACM waste can be accepted at the MCB Camp Lejeune Sanitary Landfill. Work with the ROICC or your Contract Representative to coordinate the disposal through the MCBCL Landfill office at (910) 451-2946.

- **Removal Requirements.** Permits for asbestos removal or demolition must be obtained when RACM present exceeds 160 linear feet, 260 square feet, or 35 cubic feet. Additionally, proper work practice procedures must be followed during demolition or renovation operations.

- **Renovation Notification**. If RACM is present within a structure, North Carolina law requires notification of renovation 10 working days prior to starting renovation.

6.1.3 Environmental Management System

Practices, or activities, associated with asbestos management include the following:

- Building maintenance–general
- Construction/demolition

- Equipment operation and maintenance
- Parts replacement

The potential impacts of these activities on the environment include soil contamination and degradation of water quality, air quality, and quality of life.

6.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding ACM, including the following:

- **Asbestos Hazard and Emergency Response Act (AHERA)**, **1986**. AHERA was written primarily to provide officials in schools, grades K-12, with rules and guidance for the management of asbestos-containing materials.

- **Asbestos School Hazard Abatement Reauthorization Act (ASHERA), 1992. This act** extended AHERA regulations to cover public and commercial buildings

- **National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart A, General Provisions, and Subpart M, Asbestos, 40 CFR 61.** Includes standards for asbestos demolition and renovation, disposal, and administrative requirements.

- **Naval Facilities Guide Specifications and Engineering Control of Asbestos Materials.** Covers the requirements for safety procedures and requirements for the demolition, removal, encapsulation, and disposal of asbestos-containing materials.

- **North Carolina Asbestos Hazard Management Program, NC General Statutes Chapter 130A, Article 19; 10A NCAC 41C .0601–.0608 and .0611.** Incorporates 40 CFR Part 763 and 29 CFR 1926.1101 by reference and outlines criteria for asbestos exposures in public areas, accreditation of persons conducting asbestos management activities, and asbestos permitting and fee requirements.

- **Safety and Health Regulations for Construction, Asbestos, 29 CFR 1926.1101**. Regulates asbestos exposure in construction activities.

6.3 RESPONSIBILITIES BEFORE A DEMOLITION OR RENOVATION PROJECT

Prior to starting a demolition or renovation project, contractors must:

- Know whether ACM or PACM is present in the buildings involved in the project,
- Complete the necessary notifications,
- Understand what actions to take if ACM or PACM is unexpectedly encountered during project execution, and
- Know how to properly dispose of ACM.

The ROICC or Contract Representative is required to notify Camp Lejeune's Asbestos Program Manager of all work involving asbestos removals, including glove bag projects.

6.3.1 Identification of ACM and PACM

Contract documents will identify the presence of ACM and PACM. Contact your ROICC or Contract Representative with questions regarding the presence of ACM or PACM as identified in these documents.

6.3.2 Notification

To maintain accurate files and records, the ROICC or Contract Representative is required to notify the EMD Asbestos Program Manager, who is part of the Installations and Environment Department, of all work involving asbestos removals, including glove bag projects.

A demolition/ renovation notification form DHHS 3768 must be submitted to the NCHHCU 10 working days in advance of demolition activities, regardless of whether asbestos is present.

A demolition/renovation notification form DHHS 3768 must be submitted to the NC Health Hazards Control Unit (NCHHCU) 10 working days in advance of demolition activities, regardless of whether asbestos is present. This form must be posted on-site during the entire duration of the project. Have your ROICC or Contract Representative contact the Asbestos Program Manager with questions or concerns about requirements for notification of demolition or renovation.

6.3.3 Removal

If ACM is present, it must be removed before the area is disturbed during renovation or demolition activities (except in certain rare instances). Certification and handling requirements for asbestos removal are provided in 10A NCAC 41C and the Asbestos NESHAP. Refer to these regulations for detailed requirements.

6.3.4 Training

North Carolina regulations require that all persons who perform asbestos management activities in the State of North Carolina must be accredited by the NCHHCU under the appropriate accreditation category (i.e. Building Inspector, Project Supervisor, Abatement Worker). Training documentation should be available upon request.

6.4 RESPONSIBILITIES DURING A DEMOLITION OR RENOVATION PROJECT

Form DHHS 3768 *must* be posted on-site during all permitted projects.

North Carolina regulations require that Form DHHS 3768, *Asbestos Permit Application and Notification for Demolition and Renovation,* be posted on-site during all permitted projects. Contractors must post this form when the project will remove the following: 35 cubic feet, 160 square feet, or 260 linear feet of RACM or asbestos that might become regulated as a result of handling. The form must also be posted for nonscheduled asbestos removal that will exceed these numbers in a calendar year.

During a renovation or demolition project, if the contractor suspects additional ACM, the contractor must immediately report the suspected area to the ROICC or Contract Representative.

During a renovation or demolition project, if the contractor suspects the presence of additional ACM other than those materials identified in contract documents, the contractor must immediately report the suspected area to the ROICC or Contract Representative. Before proceeding, the facility must be inspected by a person who has been trained and accredited in North Carolina as an asbestos building inspector by the NCHHCU. The individual performing the asbestos survey will coordinate with the ROICC or Contract Representative throughout the process. A legible copy of the building inspection report must be provided to the NCHHCU prior to each demolition and upon request for renovations; a building inspection report will be acceptable only if the inspection was performed during the three

years before the demolition. A copy of the report should also be forwarded to the Asbestos Program Manager.

For glove bag project requirements, please refer to 29 CFR 1926.1101 for specific work procedures.

6.5 DISPOSAL OF ACM WASTE

Contractors can dispose of ACM waste at the MCB Camp Lejeune Sanitary Landfill after first coordinating with the MCBCL Landfill office, through their ROICC or Contract Representative. The contractor must provide the MCBCL Landfill with Form DHHS 3787, *North Carolina Health Hazards Control Unit's Asbestos Waste Shipment Record.* The form must be submitted to NCHHCU for all permitted asbestos removal projects by the contractor.

7.0 LEAD-BASED PAINT

The improper removal of lead-based paint (LBP) may result in the production of paint chips and dust, which may contaminate a structure inside and out. The North Carolina Department of Health and Human Services (NCDHHS) regulations require any person who performs an inspection, risk assessment, or abatement to be certified. NCDHHS also requires a person who conducts an abatement of a child-occupied facility or target housing to obtain a permit for the abatement.

7.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with LBP activities. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

7.1.1 Key Definitions

- **Abatement.** The permanent elimination of lead-based paint hazards.
- **Demolition.** The removal of any load-bearing walls or structure.
- **Inspection.** A surface-by-surface investigation to determine the presence of lead-based paint and a report explaining the results of the investigation.
- **Lead-Based Paint (LBP).** Surface coatings that contain lead in amounts equal to or in excess of 1.0 milligram per square centimeter, or more than 0.5 percent by weight, per 40 CFR 745.
- **Lead-Containing Paint.** Surface coatings that contain lead in any amount greater than the laboratory reporting limit but less than 1.0 milligram per square centimeter, or less than 0.5 percent by weight, per 29 CFR 1926.62 and 29 CFR 1910.1025; also contained in 40 CFR Part 745 Subpart L, and have been adopted by the State of North Carolina under NC General Statute Chapter 130A, Article 19A.

- **Renovation.** Alteration of a facility or its components in any way.

7.1.2 Key Concepts

- **Disposal.** Analysis is required to determine proper disposal of waste (nonhazardous or hazardous). A Toxic Characteristic and Leaching Process analysis must be conducted to determine whether lead levels have exceeded 5 parts per million, which is the RCRA level for hazardous waste determination.

- **Lead-Based Paint Survey.** A lead-based paint survey is required prior to the disturbance of painted surfaces to determine whether the paint meets the criteria of a lead-based paint.

- **Training.** Lead-based paint training requirements set forth by the Occupational Safety and Health Administration (OSHA) are to be followed by personnel involved in all lead-based paint removal activities. MCBCL Base Safety tracks this training for contract staff, as the Safety Office houses the Lead Program Manager.

7.1.3 Environmental Management System

Practices, or activities, associated with LBP include the following:

- Construction/demolition
- Hazardous material storage
- Hazardous material transportation
- Paint removal

The potential impacts of these activities on the environment include the potential degradation of soil, water, and air environments, and the potential exposure of Installation occupants. Camp Lejeune still contains living quarters that have lead-based paint on the inside of the structures.

7.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding LBP activities, including the following:

- **Naval Facilities Engineering Service Center, Facilities Management Guide for Asbestos and Lead.** Ensures the protection of workers, building occupants, and the environment.

- **10A NCAC 41C .0800, Lead-Based Paint Hazard Management Program.** Requires (1) all individuals and firms involved in LBP activities to be certified and (2) all LBP activities to be carried out in accordance with 40 CFR 745.

- **29 CFR 1926, Safety and Health Regulations for Construction.** Contains OSHA requirements for construction activities where workers may have contact with lead.

- **40 CFR Part 745, Lead-Based Paint Poisoning Prevention in Certain Residential Structures.** Ensures that (1) lead-based paint abatement professionals, including workers, supervisors, inspectors, risk assessors, and project designers, are well trained in conducting LBP activities and (2) inspections for the identification of LBP, risk assessments for the evaluation of LBP hazards, and abatements for the permanent elimination of LBP hazards are conducted safely, effectively, and reliably by requiring certification of professionals.

7.3 RESPONSIBILITIES BEFORE RENOVATION OR DEMOLITION

Prior to any renovation or demolition aboard the Installation that involves the disturbance of painted surfaces, a LBP survey must be completed by a certified inspector, retained through the ROICC or Public Works (PW) offices. Certain projects will use PW staff to conduct the sampling and other projects will use contracted personnel. Buildings constructed prior to 1978 are assumed to contain LBP; therefore, no LBP survey is necessary. The LBP survey (through sampling and analysis) will determine whether painted surfaces meet the criteria of LBP (lead content equal to or greater than 1.0 milligram per square centimeter as measured by X-ray fluorescence (XRF) or lab analysis, or 0.5 percent by weight). For contracts where LBP is to be removed prior to demolition or renovation, the associated Naval Facilities Guide Specifications and contract documents must be implemented.

Buildings constructed prior to 1978 are assumed to contain LBP.

7.4 PERMITS

Contractors must obtain Lead Removal permits from NCDHHS when lead paint is removed from targeted housing (child-occupied facilities and housing built prior to 1978).

7.5 DISPOSAL

If the LBP survey determines that LBP will be abated as part of a renovation or demolition project, analytical samples must be taken to determine whether the material is hazardous.

If the LBP survey determines that LBP will be abated as part of a renovation or demolition project, analytical samples must be taken by the contractor to determine whether the material is hazardous. Usually a Toxic Characteristic Leaching Process (TCLP) sample is collected from a "representative" sample of the material removed. The laboratory conducting the sample analysis must be accredited by the Environmental Lead Laboratory Accreditation Program (ELLAP). A list of these accredited labs is available by contacting (703) 849-8888.

If the LBP is removed from the underlying building material, then the paint is the waste stream. If the LBP is removed with the building material, then both materials are considered the waste stream.

If the lead content is below hazardous waste (HW) regulatory disposal levels, consult with your ROICC or Contract Representative to determine whether your contract allows for the disposal material in the MCB Camp Lejeune Sanitary Landfill.

If the abated LBP is above HW regulatory levels, refer to Section 4.0 of this guide for information on HW management and disposal requirements.

7.6 TRAINING

Before the project begins, workers who are subject to exposure of lead during abatement or removal activities must be trained according to the OSHA regulation in 29 CFR 1926.62 concerning lead exposure in construction. The contractor is responsible for providing this training.

8.0 STORMWATER

There are three types of stormwater discharge that contractors for the Installation must address if they plan on disturbing land: industrial, construction, and post-construction stormwater runoff. The general requirements for each area as they apply to contractors are discussed in the following subsections.

8.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with stormwater. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

8.1.1 Key Definitions

- **Best Management Practices (BMPs).** Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of Waters of the United States. BMPs can include treatment requirements, operational procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may also denote structural and nonstructural stormwater treatment devices and measures.
- **Erosion and Sedimentation Control Plan.** Any plan, amended plan, or revision to an approved plan submitted to the North Carolina Division of Land Resources or delegated authority in accordance with North Carolina General Statute 113A-57. Erosion and Sedimentation Control Plans show the devices and practices that will retain sediment generated by the land-disturbing activity within the boundaries of the tract during construction and upon development of the tract.
- **Land Disturbance.** Areas that are subject to clearing, excavating, grading, stockpiling earth materials, and placement/removal of earth material.
- **Nonpoint Source Discharge.** All discharges from stormwater runoff that cannot be attributed to a discernible, confined, and discrete conveyance.

- **Point Source Discharge.** Any discernible, confined, and discrete conveyance, including but specifically not limited to, any pipe, ditch, channel, tunnel conduit, well, discrete fissure, container, rolling stock, or concentrated animal feeding operation from which pollutants are or may be discharged to Waters of the State.
- **Stormwater.** Stormwater runoff, snow melt runoff, and surface runoff and drainage, per 40 CFR 122.
- **Stormwater Associated with Construction Activities.** The discharge of stormwater from construction activities including clearing, grading, and excavating that result in a land disturbance of equal to or greater than 1 acre, per 40 CFR 122.
- **Stormwater Associated with Industrial Activities.** The discharge from any conveyance that is used for collecting and conveying stormwater and that is directly related to manufacturing, processing, or raw materials storage areas from an applicable industrial plant or activity, per 40 CFR 122.

8.1.2 Key Concepts

- **Operational Requirements.** Equipment, discharge, and material use requirements that apply to all construction and industrial activities.
- **Permit Requirements.** Land-disturbing projects may be subject to a variety of permit requirements to protect surface water quality from both construction and post-construction stormwater runoff. In the applicable areas of the Installation, a State Stormwater Management Permit and coverage under the Construction General Permit may be required.
- **Post-Construction.** The management of stormwater generated on a stable, established site after the construction process is complete. The State Stormwater Management Program sets forth requirements for post-construction stormwater runoff control.

8.1.3 Environmental Management System

Practices, or activities, associated with stormwater include the following:

- Catch basin cleaning
- Construction/demolition

- Erosion control
- Fuel storage–containers
- Hazardous material storage
- Land clearing
- Landscaping
- Mowing
- Outfall cleaning
- Range residue clearance
- Riparian buffer maintenance
- Runoff sedimentation basins
- Sediment traps
- Soil excavation/grading/grubbing
- Stormwater collection/conveyance system
- Stormwater engineering controls operation and maintenance
- Stump/brush removal
- Vehicle parking

The potential impacts of these activities on the environment include degradation of water quality and damage to public & private property due to flooding.

8.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding potential stormwater contamination, including the following.

- **40 CFR 122, National Pollutant Discharge Elimination System.** Requires permits for the discharge of pollutants from any point source into Waters of the United States.
- **15 NCAC 02H. 0100, Point Source Discharges to the Surface Waters.** Requires permits for control of sources of water pollution by providing the requirements and procedures for application and issuance of state NPDES permits for discharge from an outlet, point source, disposal system discharging to the surface waters of the state, and for the construction and operations of treatment works with such a discharge.
- **15A NCAC Chapter 4.** Requires all persons conducting land-disturbing activity to take all reasonable measures to protect

all public and private property from damage caused by the release of sediments from the activity. The primary tool used to accomplish the objective is the development of an Erosion and Sedimentation Control Plan. The plan must

- Identify critical areas,
- Limit exposure areas,
- Limit time of exposure,
- Control surface water,
- Control sedimentation, and
- Manage stormwater runoff.

- **15A NCAC 02H. 1000 Stormwater Management**. The State Stormwater Management Program requires all persons conducting land-disturbing activities that (1) require a Coastal Area Management Act (CAMA) Major Development Permit or an Erosion and Sedimentation Control Plan, and (2) are located within coastal counties or drain to specific classifications of water bodies, to protect surface waters and highly productive aquatic resources from the adverse impacts of uncontrolled high-density development or the potential failure of stormwater control measures. To receive permit approval, projects must limit the density of development, reduce the use of conventional collection systems in favor of vegetative systems, and incorporate post-construction, structural BMPs.

Any project involving land-disturbing activities aboard the Installation has been reviewed by the Installation's NEPA Review Board prior to the onset of work.

8.3 Prior to Site Work

8.3.1 Notifications

Any project involving land-disturbing activities aboard the Installation has been reviewed by the Installation's National Environmental Policy Act (NEPA) Review Board prior to the onset of work. Documentation of this review should have been provided to your ROICC or Contract Representative and may include mandatory conditions affecting the construction/implementation of the project. Consult with your ROICC or Contract Representative to obtain or review any NEPA documentation associated with the project in your contract.

8.3.2 Stormwater Phase I Permit

Discharges of industrial stormwater have the potential to contain contaminants from industrial activity. This type of discharge is defined

and regulated in 40 CFR 122, the USEPA final rule regarding National Pollutant Discharge Elimination System (NPDES) stormwater permitting.

Daily industrial operations discharging stormwater aboard MCB Camp Lejeune and MCAS New River are covered under NPDES Permit NCS000290.

8.3.3 Project-Specific Permits

Contractors are responsible for preparing all project-specific stormwater permit applications and related plans and for coordinating the permit review schedule with the ROICC or Contract Representative. For projects located outside of Public-Private Venture (PPV) housing, MCB Camp Lejeune is the responsible party for all project-specific stormwater permits. (All permit-required plans and applications must go through internal approval before being submitted to the appropriate state agency.) The permit review schedule should allow adequate time for internal review prior to state submission deadlines. For housing-related projects located outside of the jurisdiction of MCB Camp Lejeune, stormwater compliance should be coordinated with the appropriate PPV contractor.

Contractors are responsible for preparing all project-specific stormwater permit applications and related plans and for coordinating the permit review schedule with the ROICC or Contract Representative.

For construction activities that disturb one acre or more of land, permit coverage is required under the North Carolina General Permit No. NCG010000 (General Permit). To obtain coverage under the General Permit, three copies of a proposed Erosion and Sedimentation Control Plan must be prepared and submitted to the NCDENR Sedimentation Control Commission (or to an approved local program) at least 30 days prior to beginning construction activity. Another copy of the plan will be kept on file at the job site. **Coverage under the permit becomes effective upon issuance of a plan approval. No land-disturbing activities may take place prior to receiving plan approval.** The approved plan is considered a requirement or condition of the General Permit; deviation from the approved plan will constitute a violation of the terms and conditions of the permit unless prior approval for the deviations has been obtained.

All permit-required plans and applications must go through internal approval before being submitted to the appropriate state agency.

A State Stormwater Management Permit, issued in accordance with 15A NCAC 02H. 1000, is required for all development activities that require a CAMA Major Development Permit or an Erosion and Sedimentation Control Plan and that meet any of the following criteria:

- Development within the 20 coastal counties

- Development that drains to an Outstanding Resource Water (ORW)
- Development within one mile of and draining to a High Quality Water (HQW)

A State Stormwater Management Permit is required for all activities that will disturb one acre or more of land.

Because the Installation is located in a coastal county, any project that disturbs greater than one acre of land (hence requiring coverage under the General Permit for construction activity) will also require a State Stormwater Management Permit. A State Stormwater Management Permit Application must be submitted and filed with the NCDENR, Division of Water Quality, following completion of the construction plans and specifications and prior to commencement of construction activities. Copies of this form are available at the NCDENR website: <http://h2o.enr.state.nc.us/su/Forms_Documents.htm#sswmp>. The State Stormwater Management Permits typically specify design standards for conveyance systems and structural BMPs, a schedule of compliance, and general conditions to which the permittee must adhere.

8.4 Responsibilities During Site Work

The contractor is responsible for maintaining the quality of the stormwater runoff and preventing pollution of stormwater at the construction/job site. The job site may be inspected by Installation environmental personnel to ensure compliance with the Installation Stormwater Pollution Prevention Plan and applicable permits. The following requirements apply to all projects occurring at the Installation that have the potential to impact water quality:

- Any changes to the project area that do not comply with the approved Erosion and Sedimentation Control Plan, alter the approved post-construction stormwater conveyance system, or could otherwise significantly change the nature or increase the quantity of pollutants discharged should be immediately communicated to the ROICC or Contract Representative.
- Equipment utilized during the project activity must be operated and maintained in such a manner as to prevent the potential or actual pollution of the surface or ground waters of the state.
- All permitted erosion and sedimentation control projects will be inspected by the contractor at least once every seven calendar days

(unless discharges to a 303(d)-Listed water body are occurring) and within 24 hours after any storm event greater than 0.5 inch of rain per 24-hour period, as required by the North Carolina General Permit No. NCG010000 (General Permit). Inspection results shall be maintained by the designated contractor throughout the duration of the active construction project.

- Fuels, lubricants, coolants, hydraulic fluids, or any other petroleum products shall not be discharged onto the ground, into surface waters, or down storm drains (to include leaking vehicles, heavy equipment, pumps and/or structurally deficient containers of hazardous materials).
- Spent fluids shall be disposed of in a manner so as not to enter surface, ground waters of the state, or storm drains. Disposal of spent fluids is outlined in Section 4.0.
- Implement spill prevention measures, clean up all spills immediately, and follow spill reporting requirements presented in Section 3.0. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner so as not to allow their entry into the water, surface or ground, of the state. Please refer to Section 3.0 for emergency and spill response procedures.
- Herbicide, pesticide, and fertilizer usage during construction activity shall be consistent with the Federal Insecticide, Fungicide, and Rodenticide Act and shall be in accordance with label restrictions. Please refer to Section 4.0 for additional information on Hazardous Material/Hazardous Waste Management.
- Particular care must be used when storing materials outside. Materials and equipment stored outside that could potentially affect the quality of stormwater runoff include, but are not limited to, garbage dumpsters, vehicles, miscellaneous metals, wood products, and empty storage drums. If there is any question about whether an outdoor storage practice is acceptable, contact the ROICC or Contract Representative.
- Use good-housekeeping practices to maintain work areas in a clean and orderly manner, paying particular attention to those areas that may contribute pollutants to stormwater.

9.0 SOLID WASTE, RECYCLING, AND POLLUTION PREVENTION

The Installation has a proactive pollution prevention (P2) and recycling program. Contractors should minimize the amount of solid waste requiring disposal in a landfill. This section addresses solid waste, including both municipal solid waste (MSW) and construction and demolition (C&D) waste. Hazardous materials and hazardous waste are discussed in Section 4.0 of this guide. Contractors are required to comply with all Federal, state, and local laws and regulations for proper disposal and recycling of all solid wastes.

Contractors should minimize the amount of solid waste requiring disposal in a landfill.

9.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with solid waste, recycling, and pollution prevention. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

9.1.1 Key Definitions

- **Construction and Demolition (C&D) Debris.** Materials generated during the construction, renovation, and demolition of buildings, roads, and bridges. C&D debris often contains bulky, heavy materials that include concrete, wood (from buildings), asphalt (from roads and roofing shingles), gypsum (the main component of drywall), etc.
- **Green Procurement (GP).** The purchase of environmentally preferable products and services in accordance with Federally mandated “green” procurement preference programs. GP is intended to protect the environment and reduce energy consumption.
- **Pollution Prevention (P2).** Reducing the amount of a hazardous substance or pollutant entering waste streams or otherwise released to the environment prior to recycling, treatment, or disposal.
- **Recycling.** A series of activities that includes collecting, sorting and processing recyclables into raw materials, and manufacturing raw

materials into new products per the US Environmental Protection Agency (USEPA).

- **Solid Waste.** Any solid, semisolid, liquid, or contained gaseous materials discarded, including garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants or from air pollution control facilities, and other discarded materials, per the Resource Conservation and Recovery Act (RCRA) of 1976.

9.1.2 Key Concepts

- **Pollution Prevention/Green Procurement.** Pollution prevention and green procurement practices are strongly encouraged for Installation contractors.
- **Recycling.** Recycling is required on the Installation. The MCBCL Recycling Center accepts specified recyclables.
- **Solid Waste.** The location for disposal of solid waste will be in accordance with contract specifications (off-base or MCBCL Landfill). Data related to off-base disposal (to include C&D waste) must be provided to the ROICC or Contract Representative on a monthly basis.

9.1.3 Environmental Management System

Practices, or activities, associated with solid waste, recycling, and pollution prevention, include the following:

- Battery replacement
- Building maintenance–general
- Building operation–general
- Construction/demolition
- Equipment disposal
- Hazardous waste recycling
- Land clearing
- Material storage handling
- Packaging/unpackaging
- Rock crushing operations
- Solid waste recycling collection/transportation
- Stump/brush removal

- Vehicle operation

The potential impacts of these activities on the environment include soil degradation, surface water quality degradation, depletion of landfill space, and depletion of nonrenewable resources.

9.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding solid waste disposal, recycling, and pollution prevention, including the following:

- **Base Order (BO) 5090.4, Solid Waste Reduction – Qualified Recycling Program (QRP)**. Provides guidance for solid waste reduction, pollution prevention, and management of recyclable materials.
- **BO 11350.2D, Refuse Disposal Procedures**. Establishes procedures for the separation, collection, and disposal of refuse and the disposal of waste wood products.
- **Pollution Prevention Act (PPA) of 1990 (42 U.S.C. 13101 *et seq*.)**. Establishes the national policy that "pollution should be prevented or reduced at the source whenever feasible," and establishes the following hierarchy: source reduction, recycling, treatment, and disposal.
- **Resource Conservation and Recovery Act (RCRA) of 1976**. Governs the disposal of solid waste and establishes Federal waste disposal standards and requirements for state and regional authorities. The objectives of Subtitle D are to assist in developing and encouraging methods for the disposal of solid waste that are environmentally sound and that maximize the utilization of valuable resources recoverable from solid waste.
- **Solid Waste Disposal Act (SWDA) of 1965**. Requires Federal facilities to comply with all Federal, state, interstate, and local requirements concerning the disposal and management of solid wastes.

At a minimum, the following actions are required by all contractors:

1. Prior to performing work that will or may generate solid waste at the Installation, all contractors must provide their ROICC or Contract

Representative with a copy of their Solid Waste Disposal Permit unless MCBCL's landfill is being utilized for disposal. Recycling is encouraged and can be coordinated with the ROICC or Contract Representative and the Landfill Manager.

2. Provide the weights of ALL wastes, both solid and C&D that are either disposed of or recycled to the ROICC or Contract Representative with a copy to the Landfill Manager. This requirement does not apply in instances where the Landfill/Recycling facility picks up or accepts materials directly from the contractor. If contractors are transporting waste off-site for disposal, it is mandatory that they track the material weight and provide that information to their ROICC or Contract Representative.

9.3 SOLID WASTE REQUIREMENTS

Contractors producing solid waste on the Installation are required to take these steps:

- Pick up solid waste and place it in covered containers that are regularly emptied.
- Prevent contamination of the site and the surrounding areas when handling and disposing of waste.
- Leave the project site clean upon completion of a project.

9.3.1 MCBCL Landfill Acceptable Waste Streams

The MCBCL Landfill accepts certain types of solid waste under the conditions specified in Table 9-1. MCBCL Landfill hours of operation are 0800 to 1530, Monday through Friday. Contractors must have a construction pass and a copy of the face of the related contract to enter the MCBCL Landfill and dispose of waste. Contractors must also contact the Landfill Operator prior to unloading refuse. Each material must be separated into different loads.

Table 9-1. MCBCL Landfill Requirements

Waste Category [a]	Example	Requirements
Mixed Debris	Sheetrock, plaster, ceramic tiles	• Items may be mixed together
Painted Masonry and Concrete	Concrete, block, brick	• Separate from other items • Lead-painted or mastic-contaminated masonry or concrete must be separated from unpainted concrete products • Remove reinforcement wire and rebar flushed with exposed surfaces
Unpainted Masonry and Concrete	Concrete, block, brick	• Separate from other items • Remove reinforcement wire and rebar flushed with exposed surfaces
Nonrecyclable Cardboard	N/A	• Dispose of cardboard only if the MCBCL Recycling Center has rejected the cardboard
Nonrecyclable Wood Pallets	N/A	• Dispose of pallets only if the MCBCL Recycling Center has rejected the pallets
Treated Wood	Piling, power poles	• Separate from other items
Untreated/Unpainted Wood	Lumber, stumps, limbs	• Separate from other items
Organic Matter	Leaves, grass clippings	• Separate from other items • No bags or containers are allowed
Fiberglass Tanks	N/A	• Clean tanks before delivering to the landfill

[a] Metals are not accepted at the landfill and must be removed from each waste category prior to disposal. Metal construction debris should be disposed of at the DRMO. Disposal requirements set forth in BO 11350.2D should be followed.

9.4 RECYCLING REQUIREMENTS

The Installation Recycling program is managed by the MCBCL Landfill, with assistance from the EMD. The MCBCL Landfill plays a vital role in the Installation's effort to reduce the amount of solid waste requiring disposal. Reducing solid waste saves money and helps to protect the environment by conserving natural resources. Additionally, Marine Corps facilities are mandated to recycle.

9.4.1 MCBCL Recycling Center

The MCBCL Recycling Center, Bldg. 982, is co-located with the landfill on Piney Green Road. Normal working hours are Monday through Friday, 0730–1530. All materials can be brought to the Recycling Center. For details, have your ROICC or Contract Representative contact the Recycling Center for details at (910) 451-2946. The following types and categories of materials are accepted for recycling at the Recycling Center:

- Wood pallets
- White Paper (mixed flat or shredded)
- Newspaper
- Magazines
- Military publications (binders removed)
- Phone books
- Plastic and glass (containers or bottles)
- Toner cartridges

The following types and categories of materials are accepted for recycling but must be delivered to the Defense Reutilization and Marketing Office (DRMO) at Lot 203:

- Scrap metal
- Steel (high temperature, corrosion resistant)
- Brass (includes spent/fired munitions)
- Copper and copper wire
- Aluminum (plate, sheet, scrap) and aluminum cans

Special arrangements can be made for other materials (C&D debris) or larger volumes of commonly recycled materials from events such as

construction and deconstruction. Regulations set forth in BO 11350.2D must be followed.

9.4.2 Other Recyclables

- **Asphalt Pavement.** Asphalt must be removed and delivered to an asphalt recycling facility. Contractors must provide a record of the total tons of asphalt recycled and the corporate name and location of the recycling facility to their ROICC or Contract Representative, with a copy to the Landfill Manager.
- **Empty Metal Paint Cans.** Empty metal paint cans shall be taken to Bldg. S-962 for recycling. All HM cans or HM containers that are generated from MCBCL or Marine Expeditionary Force contracts will be turned into Bldg. S-962 on Michael Rd. on the scheduled contractor turn-in day. Have your ROICC or Contract Representative contact EMD at (910) 451-1482 for more information. Any waste generated from this process must be managed appropriately.
- **Other Metals.** Other metals must be taken to the DRMO disposal area in Lot 201.
- **Red Rags Recycling.** A basewide program is in place to supply and launder shop rags through an off-site contractor, Aramark, in Savannah, Georgia. Almost all work centers on the Installation use this “Red-Rags” service wherein clean rags are supplied by the contractor and picked up after use. The rags are then laundered off-site and returned. This has reduced rag/POL-contaminated non-regulated waste by over 85 percent.
- **Universal Waste.** See Section 4.0 of this guide for management procedures.
- **Unused Hazardous Materials.** These materials can be turned into Bldg. 908 HM Free Issue point on Michael Rd. Have your ROICC or Contract Representative contact the Free Issue Point at (910) 451-1718.
- **White Rags Recycling.** Analogous to the red rags program, white rags have recently been introduced into painting operations at MCB Camp Lejeune. An off-site contractor, Aramark, in Savannah, Georgia, launders used rags. The white rags have no dye in the cloth

that can interfere with painting operations. Laundering the white rags reduces disposal of paint-related waste.

9.5 POLLUTION PREVENTION AND GREEN PROCUREMENT

MCB Camp Lejeune is subject to green procurement (GP) requirements. GP implements environmentally protective principles in the procurement arena and includes preferential use of the following:

- Recovered materials products
- Biobased products
- Water and energy efficient products
- Alternatives to ozone depleting substances
- Electronics meeting Electronic Produce Environmental Assessment Tool standards
- Products that do not contain toxic chemicals, hazardous substances, and other pollutants targeted for reduction and elimination by the Department of Defense
- Alternative fuel use/increased fuel efficiency
- Environmentally preferable purchasing practices

Contractors are encouraged to employ GP practices whenever feasible.

10.0 TRAINING

It is the contractor's responsibility to ensure that every employee has the required training to perform his or her duties in compliance with Federal, state, and local regulatory requirements.

To minimize the environmental impact of operations occurring on the Installation, all civilian and military personnel, including contractors, are required to receive both Environmental Management System (EMS) and general environmental awareness training at the level necessary for their job function. The training presentation provided as Attachment A satisfies these training requirements.

To minimize the environmental impact of operations aboard the Installation, all contractors are required to receive both EMS and general environmental awareness training at the level necessary for their job function.

NOTE It is the contractor's responsibility to know and comply with Federal, state, and local regulations. Installation environmental personnel, upon request from the ROICC or Contract Representative, will assist contractors with compliance issues; however, the primary burden of regulatory identification, familiarity, and compliance lies with the contractor. This training *does not* replace any required regulatory environmental training (i.e., asbestos abatement worker training) as per contract requirements. Any required environmental training should be completed *prior* to working at MCB Camp Lejeune. Copies of training records should be available upon request by federal or state regulators.

10.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with contractor training requirements. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

10.1.1 Key Definitions

None.

10.1.2 Key Concepts

- **Comprehensive Environmental Training and Education Program (CETEP).** The Marine Corps training program designed to ensure that high-quality, efficient, and effective environmental

training, education, and information are provided at all levels of the Marine Corps.

- **Environmental Management System (EMS).** The part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing, and maintaining the Environmental Policy.

- **EMS Training.** Instruction that is designed to ensure that military and civilian personnel, including contractors and vendors, become familiar with the Installation's EMS and how it functions

- **General Environmental Awareness Training.** Instruction that is designed to ensure that Installation personnel, including contractors and vendors, become familiar with the MCB Camp Lejeune and MCAS New River environmental policies and programs for regulatory compliance, natural resource conservation, pollution prevention, and environmental protection. General EMS and Environmental Awareness Training for Contractors and Vendors is required for all contractors working aboard the Installation. The training presentation is included as Attachment A. Documentation of receipt of this training should be maintained by the contractor and be available upon request.

10.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements concerning training, including the following:

- **Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management.** Requires implementation of an EMS at all appropriate organizational levels.

10.3 REQUIRED TRAINING

10.3.1 General Environmental Awareness

In accordance with Department of Defense (DoD) instructions and Marine Corps Orders (MCO), the Installation has implemented a Comprehensive Environmental Training and Education Program (CETEP). A major

component of the CETEP is to provide general environmental awareness training to all individuals associated with the installation, including contractors and vendors. Attachment A is provided to contractors and their employees performing work aboard the Installation to utilize for general environmental awareness training.

Attachment A is provided to contractors and their employees performing work aboard the Installation to utilize for EMS and general environmental awareness training.

10.3.2 Environmental Management System (EMS)

In addition to CETEP requirements, the Installation has implemented a basewide EMS per Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and DoD and Marine Corps EMS policy. The EMS highlights the fact that the authority and principal responsibility for controlling environmental impacts belong to those commands, units, offices, and personnel (including contractors and vendors) whose activities have the potential to impact the environment. Attachment A is provided to contractors and their employees performing work aboard the Installation to utilize for EMS Training.

10.3.3 Recordkeeping

All training records, including other applicable environmental training, should be maintained on-site by the contractor for review upon request.

11.0 CULTURAL RESOURCES

The Installation enjoys a rich history, and remnants of our past can be found throughout the installation. As contractors, it is your responsibility to notify the Resident Officer in Charge of Construction (ROICC) or your Contract Representative immediately if you encounter suspected archaeological sites, artifacts, or human remains during your activities.

11.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with cultural resource management. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

11.1.1 Key Definitions

- **Archaeological Resource.** Any material remains of human life or activities that are at least 100 years old and are capable of providing scientific or human understanding of past human behavior and cultural adaptation, including the site on which the remains are located. Examples include structures, tools, debris, organic waste, human remains, artistic representations, and shipwrecks.
- **Cultural Resource.** A generic term commonly used to include buildings, structures, districts, sites, and objects of significance in history, architecture, archaeology, engineering, or culture per MCO P5090.2A.
- **Historic Resource.** Any prehistoric or historic district, site, building, structure, or object significant in United States history, architecture, archaeology, engineering, or culture and included, or eligible for listing, the National Register of Historic Places (NRHP) per the National Historic Preservation Act (NHPA) of 1966 and MCO P5090.2A.

11.1.2 Key Concepts

- **Notification.** Contractors must notify the ROICC or Contract Representative if any cultural resources are encountered.

- **Policy.** It is DoD policy to preserve significant historic and archaeological resources.

11.1.3 Environmental Management System

Practices, or activities, associated with cultural resources include the following:

- Construction/demolition
- Land clearing
- Soil excavation/grading
- Stump/brush removal

The potential impacts of these activities on the environment include damage to cultural resources and degradation of soil quality.

11.2 OVERVIEW OF REQUIREMENTS

It is DoD policy to integrate the archeological and historic preservation requirements of applicable laws with the planning and management of activities under DoD control; to minimize expenditures through judicious application of options available in complying with applicable laws; and to encourage practical, economically feasible rehabilitation and adaptive use of significant historical resources.

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding cultural resources, including the following:

- **Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469 *et seq*.).** Amends the Reservoir Salvage Act to extend its provisions beyond the construction of dams to any terrain alteration resulting from any Federal construction project or Federally licensed project, activity, or program.
- **ARPA of 1979 (16 U.S.C. 470 (aa) *et seq*.** Requires Federal land managers to issue permits for the excavation or removal of artifacts from lands under their jurisdiction. The Act requires that relevant Native American tribes be notified of permit issuance if significant religious or cultural sites will be affected. It prohibits the excavation, damage, alteration, or defacement of an archaeological site unless permitted by the Federal land manager.

- **DoD Directive 4710.1, Archaeological and Historic Resources Management.** Provides policy for the management of archaeological and historic resources on land and in water under DoD control.
- **Executive Order (EO) 11593, May 13, 1971.** Requires all Federal agencies to administer cultural properties under their control. Agencies are required to direct their policies, plans, and programs so that significant sites and structures are preserved.
- **Historic Sites, Buildings, and Antiquities Act of 1935 (Public Law 74-292, 16 U.S.C. 461 *et seq*.).** States that it is Federal policy to preserve historic and prehistoric properties of national significance.
- **National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq*.).** States that it is Federal policy to preserve important historic, cultural, and natural aspects of our national heritage and that it is a requirement to consider environmental concerns during project planning and execution.
- **National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470 *et seq*.).** Establishes historic preservation as a national policy and requires Federal agencies undertaking actions that may affect NRHP-eligible historic properties to consult with state historic preservation offices and the Advisory Council on Historic Preservation. Section 110 of the Act requires Federal agencies to inventory, evaluate, identify, and protect cultural resources that are determined eligible for listing in the NRHP.
- **Public Buildings Cooperative Use Act of 1976 (Public Law 94-541).** Encourages adaptive reuse of historic buildings as administrative facilities for Federal agencies.

11.3 PROCEDURES

All contractors are expected to follow these procedures:

- Notify the ROICC or Contract Representative immediately if suspected archaeological sites, artifacts, or human remains are encountered during your activities.

Notify the ROICC or Contract Representative immediately if suspected archaeological sites, artifacts, or human remains are encountered during your activities.

- Stop work in the immediate area of the discovery until directed by the ROICC or Contract Representative to resume work.
- Be particularly aware of your surroundings when working in a designated historic area. A summary of key cultural, archaeological, and historic areas/sites is available at the following website: http://www.lejeune.usmc.mil/EMD/CULTURAL/HOME.htm

Remember, the Government retains ownership and control over historical and archaeological resources.

12.0 PERMITTING

Contractors operating aboard the Installation must ensure that all relevant environmental permits are obtained before work commences on-site. Contractors must work with their ROICC or Contract Representative to determine permitting responsibilities prior to beginning work. Contractors must adhere to all permit conditions. Examples of environmentally related permits are provided in Section 12.3.

12.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with contractor permitting requirements. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

12.1.1 Key Definitions

- **SA Waters.** Surface water that is suitable for recreation and for commercial shellfish harvesting.

12.1.2 Key Concepts

- **Permits.** Prior to beginning work aboard the Installation, consult applicable permit requirements and ensure that they are met before work begins. Copies of all applicable permits/authorizations should be retained onsite for the life of the project.

12.2 OVERVIEW OF REQUIREMENTS

Please refer to the individual sections of this Guide for applicable permitting regulations and requirements that relate to each environmental medium. Many permits have specific timetables for submittal prior to project initiation. Contractors must consult the permit requirements and ensure that the permits are obtained in the required time frame.

12.3 PROJECT PERMITS AND APPROVALS

Prior to work being awarded, the Installation-associated action proponent should have had an environmental review by the Installation's National

The NCDENR website (http://www.enr.state.nc.us) is a useful reference for determining required permits and obtaining necessary forms.

Environmental Policy Act (NEPA) Section to comply with the NEPA of 1969. The outcome of this review would have been in the form of a Decision Memorandum (DM) or an Environmental Assessment (EA). Contractors must refer to their contract and the requirements outlined in the NEPA documentation for specific permitting requirements. EMD Program Managers are available for guidance; however, if the contractor is tasked with preparing permit applications, the contractor is expected to have the necessary capability and expertise required to complete the submittals in accordance with the guidance provided by the regulatory agency that issues the permit. In addition, EMD must be provided with copies of all permits submitted to the North Carolina Department of Environment and Natural Resources (NCDENR). In some cases, EMD must submit the permit application. Please direct questions to your ROICC or Contract Representative.

Examples of permits that may be required are discussed in applicable sections of this Guide. The following list of permits is not meant to be all inclusive. Please be aware that other permits not listed in this section may be required. The NCDENR website (http://www.enr.state.nc.us) is a useful reference for determining required permits and obtaining necessary forms. In addition, any inspection and/or data collection required by the permits must be retained on site for review upon request.

12.3.1 Stormwater (Section 8.0)

- **National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit for Construction Activities (also referred to as General Permit No. NCG010000).** Required for all land-disturbing activities (LDA) that exceed one (1) acre; also requires an accompanying Erosion and Sedimentation Control Plan.

- **High-Density Stormwater Permit.** Required when the (1) LDA exceeds one (1) acre and impervious surfaces are greater than or equal to 25 percent of the total project area adjacent to non-SA waters or greater than or equal to 12 percent of the total project area adjacent to SA water; OR (2) total development exceeds 10,000 square feet of impervious surface.

- **Low-Density Stormwater Permit.** Required when the LDA exceeds one (1) acre and impervious surfaces are less than 25 percent when adjacent to non-SA waters or less than 12% when adjacent to SA waters.

12.3.2 Asbestos (Section 6.0)

- **Asbestos Permit Application and Notification for Demolition/Renovation**. DHHS Form 3768, available at the following website: http://www.epi.state.nc.us/epi/asbestos/ahmp.html

12.3.3 Air Quality (Section 13.0)

- **Clean Air Act Title V Construction and Operation Permit.** Required for the construction of the following types of emission sources:
  - Boilers
  - Generators
  - Engine Test Stands
  - Surface Coating/Painting Operations
  - Refrigerant Operations (e.g., Chillers)
  - Chemical or Mechanical Depainting, Abrasive Blasting, Grinding, or Other Surface Preparation Activities
  - Fuel Storage and Fuel Dispensing
  - Woodworking Shops
  - Welding Shops
  - Bulk Chemical or Flammables Storage
  - Open Burning
  - Fire Training
  - Rock Crushing or other dust-causing activities

  EMD must submit all permit applications directly to the North Carolina Division of Air Quality.

12.3.4 Wetlands (Section 14.0)

- Contractors working aboard the Installation will not perform any work in Waters of the United States or wetlands without an approved permit (even if the work is temporary). Unavoidable impacts to wetlands or waters of the U.S. will require coordination and written approval from the US Army Corps of Engineers for a Section 404 Clean Water Act Permit (Individual or applicable Nationwide Permit), the NC Division of Water Quality for a Section 401 Clean Water Act, Water Quality certification, and the NC Division of Coastal Management for a Federal Consistency Determination. Failure to acquire written authorization for impacts to wetlands and/or waters of the U.S. may result in significant project delays or design modifications. The action proponent must coordinate with Land and Conservation Resources Section, ECON at (910) 451-5063/7235 during project design to ensure Clean Water Act permitting issues are addressed at the earliest opportunity.

12.3.5 Drinking Water/Wastewater

- **Approval of Engineering Plans and Specifications for Water Supply Systems.** Applicant submits engineering plans and specifications at least 30 days prior to the date upon which the Authorization to Construct is desired. Must have Authorization to Construct prior to onset of work.

- **Wastewater Extension Permit.** NCDENR Form FTA 02/03 – Rev. 3 04/05. Applicant submitting Form FTA 02/03 should plan accordingly and allow the State approximately 90 days to issue the permit. Permit must be in hand prior to onset of work.

13.0 AIR QUALITY

The Air Quality Program is responsible for ensuring that the Installation complies with all applicable Federal and state air quality regulations. Your ROICC or Contract Representative can provide a copy of Base Order 5090.6, Air Quality Management, which has additional information.

13.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with air quality. If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

13.1.1 Key Definitions

- **Ozone-Depleting Substance (ODS).** Chemicals, such as certain refrigerants, that cause depletion of the stratospheric ozone layer.

- **Title V Permit.** Permit issued under the Clean Air Act Amendments (CAAA) for all major sources of air pollution. All emission sources at the Installation must be listed on the permit.

13.1.2 Key Concepts

- **Emission Sources**. Please have your ROICC or Contract Representative check with the EMD before beginning any emitting activity to determine whether any recordkeeping requirements apply.

- **Permitted Sources.** Ensure that construction permits are in place prior to beginning construction.

13.1.3 Environmental Management System

Practices, or activities, associated with air quality include the following:

- Controlled burn operations
- Degreasing
- Engine operation and maintenance
- Paint removal
- Painting

- Refrigerant replacement

The potential impacts of these activities on the environment include degradation of air quality, degradation of quality of life, and depletion of nonrenewable resources.

13.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding air quality, including the following:

- **Clean Air Act Amendments of 1990.** Protect human health and clean air resources by establishing standards and regulations for the control of air pollutants.
- **Title V Permit.** Outlines the requirements that the Installation must follow to ensure air quality compliance.
- **Base Order (BO) 5090.6, Air Quality Management.** Implements policies and procedures at the Installation level that all personnel must follow in order to demonstrate compliance with the Title V Permit and USMC requirements.
- **Base Bulletin (BBul) 6280, Open Burning of Vegetative Debris.** Outlines procedures for conducting open burning in accordance with state regulations and Installation procedures.

13.3 PERMIT REQUIREMENTS

A permit is required prior to the construction of any emission source. Timely submittal of the permit application is required to obtain the permit prior to commencing construction.

The Installation has a single permit, the Clean Air Act Title V Construction and Operating Permit, that includes all stationary air emission sources located at the facility; therefore, all permit application submittals to the North Carolina Division of Air Quality (NCDAQ) must be coordinated through the EMD. NCDAQ will review and process the application then issue a permit to construct and operate or to modify the emission source(s). A permit is required prior to the construction of any emission source. Timely submittal of the permit application is required to obtain the final permit prior to commencing construction. The most common types of emission sources at the Installation are as follows:

- Boilers
- Generators
- Engine Test Stands
- Surface Coating/Painting Operations
- Depainting (Chemical or Mechanical), Abrasive Blasting, or Other Surface Preparation Activities
- Fuel Storage and Fuel Dispensing
- Grinding
- Woodworking
- Welding
- Refrigerant Recovery and Recycling Operations or other Ozone-Depleting Substances (e.g., Halon fire extinguishing, cleaning agents)
- Bulk Chemical and Flammable Materials Storage

13.4 ADDITIONAL ACTIVITIES OF CONCERN

Other activities that do not necessarily require modification to the Title V Permit, but that must be coordinated with or tracked by EMD or the State Division of Air Quality, include:

- **Use of Refrigerants and other ODS.** Includes installation, removal, replacement, conversion, or service of chillers and other refrigerant-containing equipment.

- **Open Burning (e.g., right-of-way clearing, storm debris burning).** Only vegetative debris may be burned (i.e., NO paper products, trash, treated lumber, shingles, or other synthetic materials). Any plans to conduct open burning activities at the facility must be communicated to EMD and the Fire and Emergency Services Division. Your ROICC or Contract Representative can provide a copy of Base Bulletin 6280, which contains a summary of the Installation's open burning requirements. Any open burning activities that will take place within 1,000 feet of an occupied dwelling require a waiver and approval from occupants and NCDAQ. A waiver form can be downloaded at this site: http://daq.state.nc.us/enf/openburn/openburn_1000ft.pdf

  Five designated sites have been permitted for storing and/or burning storm debris. They are located in the following areas: Mainside on

Sawmill Road, Courthouse Bay, Camp Johnson, Camp Geiger, and MCAS New River. Only storm debris can be accumulated at these sites. EMD must notify the Division of Air Quality if the Installation intends to burn the storm debris at one of these sites. Contact your ROICC or Contract Representative for more information.

- **Fire training outside of designated fire training pits**. State approval is required to conduct fire training outside of the designated fire training pits. First, complete the Notification of Open Burning for the Training of Firefighting Personnel form. The form is available at the following site: http://daq.state.nc.us/enf/openburn/ob_firetrain.pdf

  An accredited North Carolina Asbestos Inspector must inspect any structure to be burned to ensure that it is free from asbestos before the training exercise. Turn in the completed form to EMD for submittal to NCDAQ and the Division of Public Health, Health Hazards Control Unit.

- **Dust-causing activities (e.g., rock crushing).** Wet suppression is required during the entire dust-causing operation. Ensure that an adequate water supply is available, and coordinate with the Fire and Emergency Services Division if access to a fire hydrant is necessary.

14.0 NATURAL RESOURCES

The Installation has stewardship and recovery responsibilities over the natural resources located on the installation. These responsibilities are regulated under numerous laws described in this section. The Installation ensures compliance with these laws through an interdisciplinary process of review and coordination of all activities occurring on the installation. Contractors performing work on the Installation are responsible for complying with conditions and measures imposed on their work as a result of this process; these responsibilities include preserving the natural resources within the project boundaries and outside the limits of permanent work, restoring work sites to an equivalent or improved condition on completion of work, and confining construction activities to within the limits of the work indicated or specified. The contractor is advised that the Installation is subject to strict compliance with Federal, State, and Local wildlife laws and regulations. The contractor must not disturb wildlife (birds, nesting birds, mammals, reptiles, amphibians, and fish) or the native habitat adjacent to the project area except when indicated or specified.

14.1 KEY DEFINITIONS AND CONCEPTS

The following key definitions and concepts are associated with natural resources management. If you have any questions or concerns about the information in this section or require assistance regarding any wildlife matters (snakes, nesting birds, nuisance wildlife) on the site or within the project area, please consult with your ROICC or Contract Representative, who will contact Environmental Conservation Branch (ECON) at 910-451-7235 (during working hours) or 910-451-7235 (after working hours).

If you have any questions or concerns about the information in this section, please consult with your ROICC or Contract Representative.

14.1.1 Key Definitions

- **Natural Resource.** Soil, water, air, plants, and animals, according to the Natural Resources Conservation Service.

- **Threatened or Endangered Species.** Federally listed plants and animals that are likely to become either endangered or extinct in the foreseeable future.

- **Wetland.** An area that is regularly saturated by surface water or groundwater and contains vegetation that is adapted for life in saturated soil conditions per the United States Environmental Protection Agency (USEPA).

14.1.2 Key Concepts

- **National Environmental Policy Act (NEPA) of 1969.** Contractors must obtain and review any NEPA documentation associated with their projects.

- **Threatened and Endangered Species.** Specific requirements regarding protected areas on the Installation apply to contractor activities.

- **Timber.** Contractors must ensure that the ROICC or Contract Representative notify the Forest Management Program prior to conducting site work. Timber will not be released to contractors without the approval of the Forest Management Program.

- **Wetlands.** Any work in Installation waters or wetlands requires a permit prior to the start of an activity.

14.1.3 Environmental Management System

Practices, or activities, associated with natural resources include the following:

- Construction/demolition
- Controlled burn operations
- Erosion control
- Land clearing
- Riparian buffer maintenance
- Soil excavation/grading
- Stump/brush removal

The potential impacts of these activities on the environment include air emissions, sedimentation, eutrophication of surface waters, degradation of

habitat, impacts to marine mammals, damage to commercial and noncommercial timber, impacts to endangered species and cultural resources, and degradation of soil quality.

14.2 OVERVIEW OF REQUIREMENTS

Contractors operating aboard the Installation must be aware of, and adhere to, all applicable regulations and requirements regarding natural resources, including the following:

- **BO 5090.11, Protected Species Program.** Sets forth regulations and establishes responsibilities to ensure conservation of threatened and endangered species and species at risk aboard MCB Camp Lejeune.

- **Clean Water Act (CWA) of 1972.** Establishes the basic structure for regulating discharges of pollutants into the Waters of the United States.

- **Marine Corps Order (MCO) P5090.2A, Environmental Compliance and Protection Manual.** Provides guidance and instruction to installations to ensure the protection, conservation, and management of watersheds, wetlands, natural landscapes, soils, forests, fish and wildlife, and other natural resources as vital Marine Corps assets.

- **NEPA of 1969 (42 U.S.C. 4321 *et seq*.).** Requires Federal agencies, including the Marine Corps, to consider the environmental impacts of projects before the decision maker proceeds with the implementation. All projects that support military training, major and minor military construction, maintenance, and natural resources management actions are reviewed for potential environmental impacts.

- **BO 11000.1D, Environmental Impact Review Procedures.** Implements the NEPA of 1969 and NEPA policy and guidance in Chapter 12 of MCO P5090.2A.

- **Rivers and Harbors Act of 1899.** Prohibits the excavation, filling, or alteration of the course, condition, or capacity of any port, harbor, or channel without prior approval from the Chief of Engineers.

14.3 National Environmental Policy Act (NEPA)

Staff specialists from various Installation departments participate in the NEPA process, which coordinates the review of projects and documents environmental impacts (or lack thereof) for projects before implementation.

Consult with your ROICC or Contract Representative to obtain or review any NEPA documentation associated with the project in your contract.

The documentation of this review process occasionally includes mandatory conditions affecting design and construction/implementation of the project. The documentation, when completed, is provided to the action proponent, who is expected to provide it to his or her ROICC or Contract Representative.

Consult with your ROICC or Contract Representative to obtain or review any NEPA documentation associated with the project in your contract. The documentation marks the end of the NEPA review process; it does not constitute approval for the proponent of the action to implement the action. Some contracts may include stipulations from the NEPA document that must be implemented prior to the onset of work to prevent environmental impacts and violations of Federal or state rules and regulations. Stipulations could include: replacing monitoring wells if damages occur from contractor operations; stopping work if contamination is encountered; notification that a wetlands permit is required; seasonal restrictions, etc.

14.4 Timber

The contractor is responsible for advising the ROICC or Contract Representative to notify the Forest Management Program at (910) 451-7223 prior to beginning site work.

Potential timber resources are identified during the NEPA process. The contractor is responsible for advising the ROICC or Contract Representative to notify the Forest Management Program at (910) 451-7223 prior to beginning site work. Additionally, the ROICC or Contract Representative and/or contractor is required to notify the Forest Management Program in the event the contract has been amended with modifications to the site location.

The Forest Management Program maintains first right of refusal for all timber products on construction projects and will determine whether the government will harvest the timber or release it to the contractor. The government retains exclusive rights for all forest products on construction projects. If the government elects to harvest the timber, only merchantable

timber will be removed. Per MCO P5090.2A, Chapter 11, "Forest products will not be given away, abandoned, carelessly destroyed, used to offset costs of contracts, or traded for products, supplies, or services."

Contractors must adhere to the following requirements when performing site work that may impact timber resources:

- Do not remove, cut, deface, injure, or destroy trees or shrubs, without authorization from the ROICC or Contract Representative.
- Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages without authorization from the ROICC or Contract Representative. (In such cases that these actions are authorized, the contractor shall be responsible for any resultant damage.)
- Protect existing trees that are to remain in place and that may be injured, bruised, defaced, or otherwise damaged by construction operations.
- With the ROICC or Contract Representative's approval, use approved methods of excavation to remove trees with 30 percent or more of their root systems destroyed.
- With the ROICC or Contract Representative's approval, remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features.

Protect existing trees that are to remain in place and that may be injured, bruised, defaced, or otherwise damaged by construction operations.

Please refer to Section 9.0 for disposal information for land-clearing debris.

14.5 Threatened and Endangered Species

With the exception of improved roadways, entry into a threatened or endangered species site or shorebird nesting area marked with signs and/or white paint is prohibited without written permission from Installation personnel. BO 5090.11 lists threatened and endangered species residing on Installation. The following restrictions apply on the Installation unless written permission is received from Installation personnel:

Entry into a threatened or endangered species site or shorebird nesting area marked with signs and/or white paint is prohibited without written permission from Installation personnel.

- Work on Onslow Beach or Brown's Island is not permitted between 1 April and 31 October. Traffic on the beaches should be limited to below the high tide line.
- Vehicles and lighting are prohibited on the beaches overnight between 1 May and 31 October.
- Construction activities are prohibited within 1500 feet of a bald eagle's nest (JD Training area).
- Cutting or damaging of pine trees is not permitted.
- Alteration of hydrology through excavation, ditching, etc., is prohibited.
- Fish and wildlife must not be disturbed.
- Water flows may not be altered; the native habitat adjacent to the project and critical to the survival of fish and wildlife may not be significantly disturbed, except as indicated or specified.

14.6 Wetlands

14.6.1 Avoidance

Contractors must incorporate avoidance and minimization measures in order to comply with the national policy to permit no overall net loss of wetlands.

In accordance with MCO P5090.2A, all facilities and operational actions must avoid, to the maximum degree feasible, wetlands destruction or degradation regardless of wetland size or legal necessity for a permit. Prior to the onset of construction, coordination with the Land and Conservation Resources Section of EMD should have taken place during project design to ensure Clean Water Act permitting issues are addressed by the contractor at the earliest opportunity. Contractors must incorporate avoidance and minimization measures in order to comply with the national policy to permit no overall net loss of wetlands.[1] Any proposed action significantly affecting wetlands must be coordinated with the Commanding Officer of MCB Camp Lejeune.

The contractor must ensure that construction of all buildings, facilities and related amenities, including earthwork, grading, landscaping, drainage,

[1] Contractor must meet concept design criteria while incorporating avoidance and minimization measures to protect wetlands, streams and Waters of the United States.

stormwater management, parking lot and paved roadway, sidewalks, site excavation, sanitary sewer system extensions, and domestic water extensions, avoids, to the maximum degree feasible, wetlands destruction or degradation.

Identified and mapped boundaries of legally defined wetlands on all Marine Corps lands within the project area will be distributed to the ROICC or Contract Representative for use (if available) and shall be included in all design products including drawings, plans, and figures.

14.6.2 Permits

All unavoidable potential impacts to wetlands or Waters of the United States require prior coordination as described in this section. Failure to acquire written authorization for impacts to wetlands and/or Waters of the United States may result in significant project delays or design modifications.

No discharge of fill material, mechanized land clearing, or any other activity is allowed in jurisdictional wetlands or Waters of the United States without the proper approvals. The contractor may be responsible for obtaining the following permits (including pre-permit coordination, preparation, and submission of all permit applications after review and concurrence by the Installation) and complying with all regulations and requirements stipulated by the State of North Carolina as conditions upon issuance of the permits:

If work in wetlands is required, be sure you know who is responsible for obtaining permits, and what the terms and conditions of the permits require.

- United States Army Corps of Engineers (USACE), Section 404 Permit (Individual or applicable Nationwide Permit); Clean Water Act (CWA) of 1977, as Amended (Public Law 95-217, 33 U. S. C. 1251 et seq.)

- North Carolina Division of Water Quality (NCDWQ), Section 401 Water Quality Certification – (15A NCAC 02H) N.C. Department of Environment and Natural Resources (NCDENR); Clean Water Act (CWA) of 1977, as Amended (Public Law 95-217, 33 U. S. C. 1251 et seq.)

- North Carolina Division of Coastal Management (NCDCM), Federal Consistency Determination (15A NCAC 07) NCDENR; Coastal Zone Management Act (CZMA) of 1972 (16 U. S. C. 1451 et seq.)

Two types of activities generally require a permit from the USACE:

- **Activities within navigable waters.** Activities such as dredging, constructing docks and bulkheads, and placing navigation aides require review under Section 10 of the Rivers and Harbors Act of 1899 to ensure that they will not cause an obstruction to navigation.

- **Activities in wetlands and Waters of the United States** (regulated by Section 404 of the CWA of 1972). A major aspect of the regulatory program under Section 404 of the CWA is determining which areas qualify for protection as wetlands. Contractors should contact the USACE, the NCDWQ, or the NCDCM if there is any question about whether performing any activities could impact wetlands.

Contractors working on the Installation will not perform any work in Waters of the United States or wetlands without an approved permit (even if the work is temporary).

Contractors working on the Installation will not perform any work in Waters of the United States or wetlands without an approved permit (even if the work is temporary). Examples of temporary discharges include dewatering of dredged material prior to final disposal and temporary fills for access roadways, cofferdams, storage, and work areas.

14.6.3 Impacts

Any disturbance to the soil or substrate (bottom material) of a wetland or water body, including a stream bed, is an impact and may adversely affect the hydrology of an area. Discharges of fill material generally include the following, without limitation:

- Placement of fill material that is necessary for the construction of any structure or impoundment requiring rock, sand, dirt, or other material for its construction; site-development fills for recreational, industrial, commercial, residential, and other uses; and causeways or road fills

- Dams and dikes

- Artificial islands

- Property protection or reclamation devices such as riprap, groins, seawalls, breakwaters, revetments, and beach nourishment
- Levees
- Fill for intake and outfall pipes and subaqueous utility lines
- Fill associated with the creation of ponds
- Any other work involving the discharge of fill or dredged material

14.6.4 Mitigation

Any facility requirement that cannot be sited to avoid wetlands must be designed to minimize wetlands degradation and must include compensatory mitigation as required by wetland regulatory agencies in all phases of project planning, programming, and budgeting.

The contractor may be required to develop on-site mitigation, consisting of wetland/stream restoration or creation for all unavoidable wetland and stream impacts whenever possible and feasible. Use of Marine Corps lands and lands of other entities may be permissible for mitigation purposes for Marine Corps projects when consistent with USEPA and USACE guidelines or permit provisions. Land within the project area suitable for establishment of wetlands mitigation may be evaluated by the contractor and used for mitigation where compatible with mission requirements and approved by the Commanding Officer. Proposals for permanent resource areas must be approved by the Assistant Secretary of the Navy (Installations and Environment) or his/her designee.

Off-site mitigation should be proposed only if there is no other reasonable compensatory mitigation alternative.

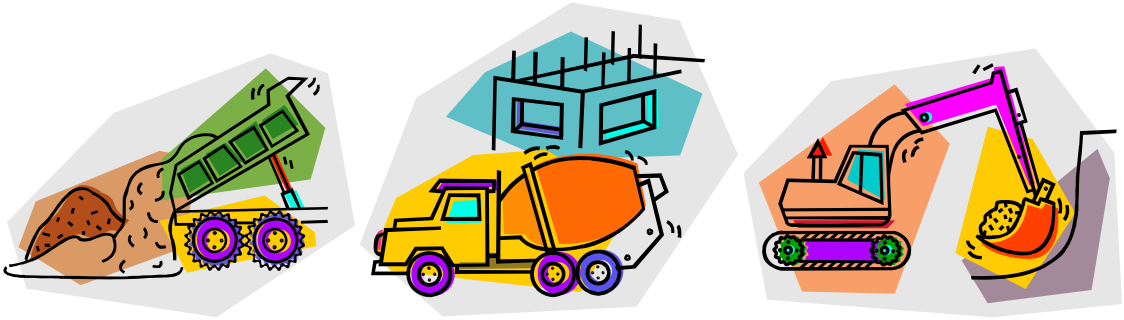
The contractor may be required to develop on-site mitigation consisting of wetland/stream restoration or creation for all unavoidable wetland and stream impacts whenever possible and feasible.

14.7 Temporary Construction

Traces of temporary construction facilities, such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other signs of construction, should be removed. Temporary roads, parking areas, and similar temporarily used areas should be graded to conform to surrounding contours.

General EMS & Environmental Awareness Training for Contractors & Vendors

Attachment (1)



MCB Camp Lejeune, NC/ MCAS New River

General EMS and Environmental Awareness Training for Contractors and Vendors

Revised: April 2008

Disclaimer

- This training does not replace any required regulatory environmental training as per your contract
  - Required environmental training should be completed *prior* to working aboard the Installation
  - Training records should be available for review upon request

Training Overview

- EMS and the Environmental Policy
- Environmental Management Division
- General Environmental Awareness
- Spill Response Basics
- Summary

EMS and the Environmental Policy

What is an EMS?

- MCB Camp Lejeune and MCAS New River have implemented an Environmental Management System (EMS) that is founded on the principles of our respective **Environmental Policy**.

- The purpose of the EMS is to sustain and enhance mission readiness and access to training areas through effective and efficient environmental management.

- The EMS emphasizes that the authority and principal responsibility for controlling environmental impacts belong to those commands, units, offices, and personnel, ***including contractors and vendors***, whose activities have the potential to impact the environment.

Why have an EMS?

"To sustain our operations and training capabilities, and to safeguard land-use availability, ……. will comply with environmental laws and conserve the natural and cultural resources with which it has been entrusted."

Excerpt from the Commanding Officer's Environmental Policy Statement

What YOU Need to Know

- The Installation has an EMS

- These three goals are the foundation of our **Environmental Policy**:

1. **Comply** with relevant environmental laws and regulations

2. **Prevent pollution**

3. **Continually improve** our EMS

YOUR **EMS Responsibilities**

- Be aware of the Environmental Policy
- Be familiar with spill procedures
- Keep your eyes open for potential problems
- Report any environmental problems or concerns promptly and notify your ROICC or Contract Representative
- Utilize this training for your workers

Environmental Management Division (EMD), MCBCL

Environmental Affairs Department (EAD), MCASNR

EMD/EAD can help!

- The appropriate environmental office works with your ROICC or Contract Representative to ensure:
  - Proper management of waste
  - Compliance with regulations
  - Required environmental plans are developed and followed, if applicable
  - Required environmental training material is provided for contractor use

What Does EMD/EAD Do for You?

- If you have EMS or environmentally related questions, contact your ROICC or Contract Representative who will then work with EMD & EAD to determine how to proceed

Remember…

ALL environmental program requirements are applicable to **ALL** contractors and vendors working aboard the Installation!

General Environmental Awareness

Water Quality

- **Construction/demolition and other projects can result in:**
  - Stormwater pollution
  - Erosion and sedimentation

- **If a project could impact water quality:**
  - Don’t dispose of oil, chemicals, or any other material/debris down storm drains
  - Keep sediment, leaves, and construction debris away from storm drains (use barriers)
  - Sediment Erosion Control Plans are required for sites when more than 1 acre will be disturbed

Used Oil

- **Oil handling/changing operations can result in:**
  - Spills
  - Waste
  - Groundwater, stormwater, or soil contamination

- **If a project involves the use of oil:**
  - Perform maintenance in paved, designated areas
  - Recycle used oil, oil filters, and other fluids…don't dump down storm drain or dispose of in the trash
  - Clean up spills immediately and properly!

Air Quality

If a project could impact air quality:

- Prior to beginning operations, have your ROICC or Contract Representative contact the Installation Air Quality Program representative for applicable Federal and state permitting requirements
- Follow all permit requirements, including material usage recordkeeping for Title V permit sources
- Notify your ROICC or Contract Representative before bringing new equipment on site
- Notify your ROICC or Contract Representative before modifying an existing permitted source (including physical changes and material changes). Examples of permitted sources include boilers, generators, fuel tanks, and welding/soldering operations

Hazardous Waste Management

- **Hazardous waste generation can result in:**
  - Consumption of natural resources
  - Increased Regulatory Burden

- **If a project generates hazardous waste:**
  - Reduce/Minimize the generation of hazardous waste
  - Contact your ROICC or Contract Representative if unsure how to manage a waste
  - Don’t put hazardous wastes into general trash dumpsters
  - Ensure satellite accumulation areas (SAA) are managed properly
    - Notify your ROICC or Contract Representative prior to creating a new SAA!
  - Ensure hazardous waste drums are labeled and lids are secured

Hazardous Materials

- **If a project requires the use hazardous material (HAZMAT):**
  - Keep flammable materials in HAZMAT lockers
  - Don’t store large quantities – keep on hand only what you will use
  - Maintain MSDSs for each material on-site
  - Place materials stored outside in secondary containment to prevent spill/reduce releases
  - Stop work if you unearth a hazardous material (i.e., ordnance) and report to your ROICC or Contract Representative

PCB and Asbestos

- **If a project generates or involves the removal of PCB or asbestos:**
  - Manage and handle PCB and asbestos only if you are properly trained

  - Manage PCB and asbestos in proper containers with appropriate labeling

Solid Waste Management

- **Solid waste generation can result in:**
  - Consumption of natural resources
  - Decreased landfill space
- **If a project generates regulated or solid waste:**
  - Reduce/Reuse/Recycle when possible; meet contract requirements for recycling
  - Contact your ROICC or Contract Representative if unsure how to manage a waste
  - Don’t put unauthorized wastes into general trash dumpsters – Recyclable products should be placed in appropriate containers & not co-mingled with solid waste
  - Don’t use government-owned dumpsters for your contractor waste and debris

Good Housekeeping

- Poor housekeeping can result in:
  - Fines, termination of contract
  - Environmental contamination, spills
  - Injuries

- Maintain good housekeeping:
  - **DO** store flammable materials in HAZMAT lockers
  - **DO** ensure containers are labeled and lids are secured
  - **DO** keep stormwater drains clear of debris
  - **DO** clean up work sites at the end of *each* day
  - **DO** clean up spills immediately and properly
  - DO clean up work area after job completion
  - **DON'T** pour material down storm or floor drains
  - **DON'T** stockpile waste – put it where it belongs!

Spill Response Basics

If You Have or See a Spill…

Call 911

Natural Resources –
Threatened & Endangered Species

- The Installation is currently home to nine federally listed endangered species: red-cockaded woodpecker (RCW), green sea turtle, loggerhead sea turtle), rough-leaved loosestrife, seabeach amaranth, piping plover, American alligator, and American bald eagle and Hirst's panic grass.

- The following restrictions apply:
  - Construction activities are restricted within 1500 ft of a bald eagle's nest
  - Vehicles & lighting are prohibited on the beaches overnight = 1 May -31 Oct
  - Cutting or damaging pine trees in not permitted
  - Fish & wildlife must not be disturbed

Natural Resources –
Wetlands

- The US Army Corps of Engineers defines a wetland as " areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

- No discharge of fill material, mechanized land clearing, or any other activity is allowed in jurisdictional wetlands or Waters of the United States without the proper approvals.

- Permits will be required

Natural Resources –
Timber

There are over 127,000 acres of forested land aboard the Installation

- The MCBCL Forest Management Program has 1st right of refusal for all timber products on construction projects
  - The following restrictions apply:
    - Do not cut or deface trees w/o authorization
    - Protect existing trees that are to remain in place
    - Do not fasten or attach ropes or cables to existing nearby trees for anchorages w/o authorization

Cultural Resources

The Installation manages a variety of historic and prehistoric archaeological sites, as well as historic structures.

- **IF YOU FIND A BONE, BOTTLE OR PIECE OF POTTERY THAT YOU THINK MIGHT HAVE ARCHAEOLOGICAL OR HISTORIC INTEREST, DON'T PICK IT UP. IF YOU FIND ANY OF THESE THINGS, MARK THE AREA & NOTIFY THE BASE ARCHAEOLOGIST, EMD AT 451-5063.**

Summary

Summary

- MCB Camp Lejeune and MCAS New River protect, preserve, and enhance their natural resources through their EMS and Environmental Policies
  - **We comply** with relevant environmental laws and regulations
  - **We prevent pollution**
  - **We continually improve** the EMS
- **YOU** are responsible for complying with applicable environmental requirements too
- If you aren't sure what to do...**ASK**!
  - Your ROICC or Contract Representative and EMD/EAD are here to help

Remember…

Consult the ***Contractor Environmental Guide*** for more detailed information pertaining to environmental requirements applicable to the work you do.

If you have any questions or concerns about the information in this training, please consult with your ROICC or Contract Representative, who will contact the appropriate environmental office if additional clarification is necessary.

SECTION 01 60 00

REQUIREMENTS FOR PESTICIDE AND HERBICIDE COORDINATION

10/10

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Certificate of North Carolina Licensed Applicator

SD-11 Closeout Submittals

Completed Field Pesticide/Herbicide Management Record Form

1.1.1 Certificate of North Carolina Licensed Applicator

A North Carolina licensed applicator is required and copies of their certificates shall be submitted to the Base Pest Management Coordinator (PMC), Public Works Division of Installation & Environmental Department, Operations Branch (910) 451-5794 as specified.

1.1.2 Field Pesticide/Herbicide Management Record Form

Following the pesticide/herbicide application, the Contractor shall complete the attached Field Pesticide/Herbicide Management Record Form and submit to the PMC. The completed forms will be submitted upon completion of the Beneficial Occupancy Date (BOD).

PART 2 PRODUCTS

2.1 PESTICIDE/HERBICIDE LIST FOR CAMP LEJEUNE

See Appendix E for approved pesticide/herbicide list.

PART 3 EXECUTION

3.1 COORDINATION WITH BASE PEST MANAGEMENT COORDINATOR (PMC)

Contractor shall coordinate with the PMC before proceeding with any pesticide/herbicide application.

Contractor must comply with Base Regulation and use only DOD approved pesticides (see Attachment E). For the latest authorized pesticide list, contact the PMC or go to the following link: http://www.lejeune.usmc.mil/emd1/Compliance/HazardousMaterialManagement/tabid/89/Default/aspx.

-- End of Section --

APPROVED PESTICIDE LIST FOR CAMP LEJEUNE NC

IPM - APPENDIX E

Updated: 7 May 2010

EPA#	Trade Name	Intended Use	REMARKS
100-1006	Demon TC	Insecticide	Approve
100-1055	WeatherBlok XT (formerly 10182-339)	Rodenticide	Approve***
100-1066	Demand CS	Insecticide	Approve
100-1091	Reward	AQUATIC weeds	Approve
100-111	Archer	Roaches	Approve
100-1117	Touchdown Herbicide	Cracks, Flowerbeds	Approve
100-1134	Monument 75WG	Weeds	Approve
100-1218	Demon Max	Insecticide	Approve
100-619	Subdue 2E (Discontinued:use until depleted)	Fungicide	Approve
100-834	Barricade 65 WG	Crabgrass,weeds	Approve
100-937	Primo MAXX	Growth Regulator	Approve
10182-100	Demon WP	Insecticide	Approve
10182-105	Demon EC	Insecticide/Gen Household	Approve
10182-107	Demon TC	Ants,Termites	Approve
10182-339	Weather Block	Rodenticide	Approve***
10182-361	Demand CS	Insecticide	Approve
10182-71	Demon WP	Insecticide	Approve
1021-1620-10182	Archer	Roaches	Approve
1021-1641-57056	Conquer	Insecticide	Approve
11540-1	ULD BP-300	Insecticide	Approve
11540-27	Pro-Control Fogger II	Insecticide	Approve
11540-9	ULD BP-100	Insecticide	Approve
11649-7	Avitrol Whole Corn	Avicide	Approve
11715-307-57076	Nylar IGR	Insecticide	Approve
12455-34	Contrac All Weather Cake	Rodenticide	Approve***
12455-69	Contrac	Rodenticide	Approve
12455-5	Rodent Cakes (Quintox)	Rodenticide	Approve***
12455-5AA	Bell Rodent Cake (Quintox)	Rodenticide	Approve***
12455-61	Liqua-Tox II	Rodenticide	Approve***
12455-69	Contrac Bait (Note: use only OUTSIDE of bldgs)	Rodenticide	Approve
12455-79	Contrac All Weather Bait Blocks	Rodenticide	Approve
12455-82	Contrac Blox (Super Size)	Rodenticide	Approve
1624-39	Tim-Bor	Termicide	Approve
1730-67	Maxforce Roach Control System	Insecticide	Approve
1730-72	Maxforce Pharaoh Ant Killer	Insecticide	Approve
1812-307	K-Tea	Algaecide	Approve
19713-60	Simazine 4L	Weeds & Vines	Approve
2217-630	MSMA Herbicide	Weeds	Approve
2217-774	Gordans Brushkiller	Poison Ivy/Vines	Approve
2217-833	SpeedZone	Weeds	Approve
2217-835	Southern Speedzone	Weeds	Approve
228-317-17545	Cool Power	Weeds	Approve
239-1349	Sevin 5 Dust	Insecticide/Miticide	Approve
239-2665	Ortho Weed B-Gone / Crabgrass Killer	Weeds/Crabgrass	Approve
241-267	Maxforce Roach Control System	Insecticide	Approve
241-299-228	Polaris AC	Herbicide	Approve
241-322	Amdro Pro Fire Ant Bait	Fire Ants	Approve
241-365	Plateau	Herbicide	Approve

EPA#	Trade Name	Intended Use	REMARKS
241-372	Sahara DG Herbicide	Cracks, Concrete	Approve
241-392	Phantom	Insecticide	Approve
241-426	Habitat (Note:only MCAS is approved for use to control alligator weeds)	Herbicide	Approve
264-738	Sencor 75	Weeds	Approve
2724-274	Golden Malrin (DOD NSN#6840-01-183-7244)	Flying insects	Approve
2724-304-50809	Gencor 5E	IGR	Approve
2724-311-50809	Gencor Fogger	IGR	Approve
2724-324-50809	Gencor Plus Fogger	IGR	Approve
2724-351	Gentrol IGR	Roaches	Approve
2724-404-50809	Petcor Flea Spray	IGR	Approve
2724-421	Altosid XR Briquets	AQUATIC mosquito larvae	Approve
2724-446	Altosid SR-20 Liquid Larvicide	AQUATIC mosquito larvae	Approve
2724-451	Prestrike IGR	Insecticides	Approve
2724-461	Quickstrike	Insecticide	Approve
2724-475	Extinguish Professional Fire Ant Bait	Fire Ants	Approve
2724-490	Precor 2000 Plus / Premise	Insecticide	Approve
279-3062	Dragnet	Insecticide	Approve
279-3105	Talstar Flowable Insecticide/Miticide	Insecticide	Approve
279-3162	Talstar lawn & Tree Flowable Insecticide/Miticide	Insecticide	Approve
279-3167	Talstar GC Granular Insecticide	Insecticide	Approve
279-3168	Talstar PL	Insecticide	Approve
279-3206	Talstar One (Pre-treat for Termites)	Insecticide	Approve
279-3206-73748	Value Line Bifenthrin	Termicide	Approve
3125-121	Baygon 2% Bait	Insecticide	Approve
3125-390	Tempo Ultra WP	Insecticide	Approve
3125-498	Tempo SC Ultra	Insecticide	Approve
352-346	Hyvar XL	Herbicide	Approve
352-439	Escort XP	Kudzu	Approve
352-627	Advion Fire Ant Bait Granular	Insecticide	Approve
352-746	Advion Ant Gel	Insecticide	Approve
352-643	TranXit	Weeds	Approve
352-651	Advion Cricket Bait	Rodenticide	Approve
352-652	Advion Cockroach Gel Bait	Insecticide/Roaches	Approve
352-664	Advion Ant Bait Arena	Insecticide	Approve
352-668	Advion Roach Arena	Roaches	Approve
352-746	Advion Ant Gel Bait	Ants	Approve
35915-12-48234	Regal Wynstar	Weeds	Approve
35977-40	Logic Fire Ant Bait	IGR	Approve
36272-14	Apicide	Bees,Wasps,Hornets	Approve
40208-2	RAZE	Crawling & Flying insects	Approve
42750-29	Weed-Hoe 108	Weeds	Approve
432-1217	TOP CHOICE Fire Ant Bait / Fipronil	Insecticide/Fire Ants	Approve
432-1223	ProStar 70 WP	Fungicide	Approve
432-1231	Illoxan 3EC (Discontinued:use until depleted)	Goosegrass,crabgrass	Approve
432-1251	Maxforce Roach Station	Insecticide	Approve
432-1254	Maxforce Gel Bait	Roaches	Approve
432-1255	Maxforce Granular Insect Bait	Insecticide	Approve
432-1256	Maxforce Ant Bait Stations	Insecticide	Approve
432-1257	Maxforce FC (Sml Roach)	Insecticide	Approve
432-1264	Maxforce FC Ant Killer Bait Gel	Insecticide	Approve
432-1318	Prokox Zenith 75 WSP	Turf Pests	Approve

EPA#	Trade Name	Intended Use	REMARKS
432-1331	Premise (Pre Construction Insecticide)	Insecticide	Approve
432-1332	Premise 75	Termiticide	Approve
432-1332-73748	Imaxx Pro	Insecticide	Approve
432-1368	Premise Gel	Insecticide	Approve
432-1375	Maxforce Fly Granular Bait	Flying insects	Approve
432-1391	Premise Foam	Termiticide	Approve
432-1449	Premise Pro	Insecticide	Approve
432-1455	Maxforce Fly Spot Bait	Insecticide	Approve
432-1460	Maxforce FC Magnum Roach Killer Bait Gel	Insecticide/Roaches	Approve
432-1483	Temprid SC	Ants, Roaches	Approve
432-667	SCOURGE	Mosquitos	Approve
432-736	Suspend EC	Ants	Approve
432-763	Suspend SC	Ants	Approve
432-772	Delta Dust	Bees,Wasps,Hornets	Approve
432-824	DeltaGard G Insecticide Granules	Ants	Approve
432-835	Delta Guard GC	Insecticide	Approve
432-836	DeltaGard G Insecticide Granules	Insecticide	Approve
432-893	Ronstar 50 WSP	Weeds,preemergent	Approve
432-900	Termidor 80 WG	Insecticide	Approve
432-901	Termidor SC	Insecticide	Approve
432-992	Drione Dust	Insecticide/Gen Household	Approve
44313-4-550	Borid	Insecticide	Approve
4787-23	Glyfos X-tra	Weeds & Vines	Approve
4816-353	Drione Insecticide	Insecticide	Approve
4822-167	OFF Deep Woods Insect Repellent-6 oz (SERVMART-GSA)	Insecticide	Locally approved
48234-15	RegalStar II Weed & Feed	Weeds	Approve
48813-1-54705	Saf-T-Side	Insecticides	Approve
499-147	Whitmire PT 270 Dursban (Discontinued:use until depleted)	Insecticide	Restricted-cxld 2001
499-156-ZA	Whitmire PT 260 Diazinon (Discontinued:use until depleted)	Insecticide	Restricted-cxld 2004
499-233	Whitmire PT 170 X-clude	Insecticide	Approve
499-235	Whitmire PT 170A X-clude	Insecticide	Approve
499-290	PT 565 Plus XLO	Roaches	Approve
499-294	Avert Dry Flowable Cockroach Bait	Insecticide/Roaches	Approve
499-294	Whitmire Avert PT310 Abamectin Dust	Insecticide/Roaches	Approve
499-304	Cy-Kick CS Prescription Treatment	Insecticide	Approve
499-362	Wasp Freeze / Wasp Stopper II Plus	Wasps, bees, hornets	Approve
499-362	Whitmire PT 515 Wasp Freeze	Insecticide	Approve
499-370	Advance 375A Select Granular Ant Bait	Insecticides/Ants	Approve
499-370	PT Advance Granular Ant Bait / Ascend Fire Ant Bait	Insecticide/Fire Ants	Approve
499-370	Whitmire PT 370 Ascend Fire Ant Stopper Bait	Insecticide/Fire Ants	Approve
499-373	PT Orthene / Orthene Crack & Crevice Residual	Ants,Roaches	Approve
499-378	Whitmire PT 150 Pyrethrum	Insecticide	Approve
499-381	PT Microcare	Insecticide	Approve
499-384	Perma Dust Boric Acid Aerosol	Roaches	Approve
499-385	Tri-Die	Insecticide	Approve
499-394	Whitmire Avert Prescript Treatment 320 Crack&CreviceGelBait	Insecticide	Approve
499-404	Ultracide Flea IGR & Adulticide	Insecticide	Approve
499-406	Avert Prescription Treatment Cockroach Bait Gel Formula 2	Insecticide	Approve
499-410	Avert Prescription Treatment TC 93B Cockroach Bait Gel	Insecticide	Approve
499-444	PT 580P (Pyrethrins) / Whitmire P.I. Contact Insecticide	Insecticide	Approve
499-444	Whitmire P.I. Contact Insecticide / PT 580P (Pyrethrins)	Insecticide	Approve

EPA#	Trade Name	Intended Use	REMARKS
499-450	Pyrethrin / PBO / UDL BP-300	Adult Mosquitos	Approve
499-450	UDL BP-300 / Pyrethrin / PBO	Insecticide/Adult Mosq	Approve
499-452	BP-100	Insecticide	Approve
499-459	Advance Dual Choice Ant Bait Stations	Insecticide	Approve
499-462	Pro-Control Plus	Insecticide	Approve
499-465	Pro-Control	Insecticide	Approve
499-470	Cy-Kick	Insecticide	Approve
499-488	PT Advance Termite Cartridge	Termites	Approve
499-488-3125	Outpost TBR	Termiticide	Approve
499-501	PT 250 Propoxur	Insecticide	Approve
499-518	PT 2% Propoxur Bait	Insecticide	Approve
50404-5	Permanone Aerosol 0.5%	Insecticides	Approve
50534-202-100	Daconil Ultrex	Fungicide	Approve
51036-330-59807	OHP 6672 50W	Fungicide	Approve
51036-392	Bifenthrin Pro	Insecticide	Approve
524-454	Honcho Plus Herbicide	Weeds & Vines	Approve
524-465	Manage (Discontinued:use until depleted, see SedgeHammer)	Nutsedges	Approve
524-475	Ranger Pro	Herbicide/Weeds	Approve
524-475	ROUND-UP PRO	Herbicide/Weeds	Approve
524-535	Quick Pro Roundup	Weeds & Vines	Approve
525-343	AquaMaster	AQUATIC herbicide	Approve
53883-118	Bifenthrin	Insecticide	Approve
53883-124	Bifen LP Granules	Insecticide	Approve
55809-3	Wasp & Hornet Killer Plus (SERVMART-GSA)	Insecticide	Locally approved
56-42	Bait Block Rodenticide	Rodents	Approve
58007-1	DEET repellent (DOD NSN:6840-01-284-3982)	Mosquitos	Approve
58007-1	Ultrathron/ arthropod repellent (DEET) (DOD NSN:6840-01-284-3982)	Mosquitos	Approve
59639-31	Orthene PCO Pellets	Insecticide	Approve
6218-47	Summit Bti Briquets	AQUATIC Mosquito larvae	Approve
627-19-260	Crossbow Brush Killer	Weeds & Vines	Approve
62719-324	Rodeo / Accord	AQUATIC herbicide	Approve
62719-37	Garlon 3A (NAVFAC Disapproved 10/9/08)	Kudzu	Disapproved
62719-37-67690	Renovate 3 (Note:labeled DANGER-follow label/PPE guidelines)	Herbicide/Weeds	Approve
62719-388	Fore 80 WP Rainshield	Fungicide	Approve
62719-397	Kerb 50 WP	Weeds	Approve
62719-40	GARLON 4	Kudzu	Approve
62719-426	Dimension EC	Weeds	Approve
62719-529	Scythe Herbicide	Cracks, Flowerbeds	Approve
63120-1	Permethrin Insect Repellent 40%	Insecticides	Approve
64245-12	Maxforce FC Lge - Fipronil	Roaches	Approve
64248-1	Maxforce Roach Control System	Insecticide	Approve
64248-10	Maxforce Ant Bait Station - Hydramethylnon	Ants/Roaches	Approve
64248-11	Maxforce FC Roach Bait Stations	Insecticide	Approve
64248-12	Maxforce Large Roach Bait F03	Insecticide	Approve
64248-14	Maxforce FC Roach Killer Bait Gel	Insecticide	Approve
64248-19	Maxforce Fine Granule Insect Bait	Ants	Approve
64248-2	Maxforce Ant Killer Bait Station	Ants	Approve
64248-21	Maxforce EC Bait Gel	Insecticide	Approve
64248-23	Maxforce Granular Bait	Insecticide	Approve
64248-5	Maxforce Roach Killer Bait Gel	Roaches	Approve
64248-6	Maxforce Ant Killer/Granular Bait	Insecticide	Approve

EPA#	Trade Name	Intended Use	REMARKS
64405-1	Bora-Care	Insect/Fungicide	Approve
64405-2	Niban Fine Granular Bait	Fire Ants	Approve
64405-8	Tim-Bor	Wood Destroying Fungi	Approve
655-802	Larva-Lur	Insecticide	Approve
66222-22	PRAMITOL 25E	Weeds	Approve
67425-14	EcoPCO ACU	Insecticide	Approve
67425-15	EcoPCO WPX	Insecticide	Approve
67425-20	EcoPCO EC	Insecticide	Approve
6754-22-5802	Drione	Insecticide	Approve
6959-5180343	Cessco 5 E	Insecticide	Approve
6959-79	Cessco 5 E	Insecticide	Approve
70506-6	Tenguard	Insecticide	Approve
7173-188	Maki Pellets (DOD NSN:6840-01-151-4884)	Rodenticide	Approve
71995-33	ROUND-UP READY TO-USE-PLUS "issued to units only thru SELF HELP Office 451-0072"	Weeds	Approve
72155-33	Bayer Advance Grub Killer	Grub Killer	Approve
72155-4	Bayer Weed Killer (Southern)(MSDS#39852)	Weeds	Approve
72155-5	Bayer Weed Killer	Crabgrass	Approve
72155-58	Tempo 2.5 SC Ultra	Insecticide	Approve
73079-2	In Tice granular bait	Roaches	Approve
73342-1	AMDRO / Spectracide Fire Ant Killer (Lowe's)	Fire Ants	Approve
73342-4	Image	Weeds	Approve
7969-209	Termidor 80 WG	Termicide	Approve
7969-210	Termidor SC T/L	Termicide	Approve
7969-212	OVER & OUT (Fipronil)(Lowe's)	Fire Ants	Approve
81880-1-10163	SedgeHammer	Nutsedges	Approve
8254-5-071050	Bird-B-Gone Transparent Bird Gel Repellent	Pigeons	Locally approved
8329-40	Biomist 1.5+7.5 ULV	Mosquitos	Approve
83487-1	Uncle Albert's Super Smart Ant Bait	Insecticide	Approve
9444-129	Borid	Insecticide	Approve
9444-131	Drax Ant Kill Gel	Insecticide	Approve
9444-135	Drax Ant Kil PF	Insecticide	Approve
9444-150	Turbo Aerosol (Aerosol Boric Acid)	Insecticide	Approve
9444-158	Purge III (NAVFAC Disapproved 8/4/2000)	Flies	Disapproved
9444-175	CB 80 Extra	Insecticide	Approve
9444-182	Air Devil Aerosol	Insecticide	Approve
9444-183	Intruder HPX Aerosol	Roaches	Approve
9444-217	D-Force HPX	Insecticide	Approve
9668-174-8845	Spectracide Fire Ant Killer Granules	Fire Ants	Approve
9688-193-8845	HOTSHOT MAXATTRAX ULTRA ROACH BAIT (12 per pk)(Lowe's)	Insecticide	Locally approved
9688-214-8845	HOTSHOT MAXATTRAX ANT BAIT (4 per pk)(Lowe's)	Insecticide	Locally approved
**********	**********	**********	**********
FIFRA Exempt	Eco Exempt IC	Insecticide	Approve
Non-Toxic	Kleer-Out - Geraniol	Fire Ants	Locally approved
Not regulated	Allure Pheromone Moth Traps	Moth	Approve
Not regulated	Bac A Zap	Bacteria/Odor/Drain Fly	Approve
Not regulated	Eco Exempt D	Insecticide	Approve
Not regulated	Eco Exempt G	Insecticide	Approve
Not regulated	EcoSMART (SERVMART-GSA)	Flying insects	Locally approved
Not regulated	Mosquito Barrier	Mosquitos	Approve

EPA#	Trade Name	Intended Use	REMARKS
Not regulated	Osmocote Slow Release	Fertilizer not pesticide	Approve
Not regulated	StorGard Pheromone Traps	Moth	Approve
Not regulated	Pyrethiums	Fruit Bug	Approve
Not regulated	Liquid Fertilizer	Housing area	Approve
Not regulated	CatchMaster Glueboards	Rodent & Insects	Approve
Approve***	Must be secured inside tamper-resistant bait boxes		

Camp Lejeune Pest Management Coordinator:Kimberly Ingram (Public Works Division/Inspection)@ 451-5794 kimberly.ingram@usmc.mil
Link to the AUL for the PMP: http://www.lejeune.usmc.mil/emd1/Compliance/HazardousMaterialManagement/tabid/89/Default.aspx
http://www.lejeune.usmc.mil/emd1/Compliance/HazardousMaterialManagement/tabid/89/Default.aspx

J-1503020-05

FIELD **PESTICIDE/HERBICIDE** MANAGEMENT RECORD FORM

Revised 18 July 2008

PROJECT#_____

Instructions: **A separate form will be filled out for EACH location or building (if treating inside AND outside of a building, need two separate forms)**. Please PRINT responses for Numbers 1-9.

1. Date of Application:_____

2. Location: 2a. (Circle One) Inside or Outside
   2b Facility name and/or Building #:_____

3. Type of Pest Control Operation:_____
   (e.g., baiting, power spray, ULV, manual application of pesticide, etc.

4. Site Description:_____
   (e.g., housing office, lawn, unimproved ground, etc.)

5. Pest: _____
   (e.g., ants, cockroaches, spiders, etc)

6. Approximate total area treated _____
   (e.g., SF (square feet), LF (linear feet), AC (acre), CF (cubic feet), EA (each-for baiting only) - Circle One

7. Applicator's Name:_____

8. Pesticide Used:
   8a. Pesticide Trade Name: _____

   8b. Pesticide Active Ingredient:_____

   8c. EPA or Country Registration#:_____

   8d. Formulation (e.g., Liquid, Granular, Gel, EC, Aerosol, etc.)_____

   8e. Total Quantity of Pesticide applied:_____
   (e.g., FL (fluid ounce), GA (gallon), ML (milliliter), LT (liter), LB (pound), DR (dry ounce), GR (gram), KG (kilogram) – Circle One

   8f. Final Concentration Applied (%):_____

9. Comments: (Survey results, wind conditions, sanitation deficiencies, etc.)
_____
_____

10. Signature of Applicator:_____

11. Certification # of Applicator: _____

SECTION 01 78 00

CLOSEOUT PROCEDURES

12/10

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-10, Operation and Maintenance Data

Equipment/product warranty list

Submit Data Package 1 in accordance with Section 01 78 23, "Operation and Maintenance Data."

SD-11 Closeout Submittals

As-built drawings

GIS Deliverables

Record of materials

Maximo requirements

Complete Submittal Package - 1 copy

Equipment/product warranty tag

1.2 PROJECT RECORD DOCUMENTS

As-Built Drawings will be submitted as specified in 1.2.1 along with GIS Deliverables which will be created and submitted within specification in section 1.2.2.

1.2.1 As-Built Drawings

"FAC 5252.236-9310, Record Drawings." In addition to the requirements of FAC 5252.236-9310, the Contractor shall survey the horizontal and vertical location of all new utilities and structures to within 0.1 feet relative to the station datum. Drawing files shall be drawn according to, and in scale with NAD-1983-UTM-Zone-18N, GCS-North-America 1983, Datum: D-North-America-1983. All utilities shall be surveyed at each fitting and every 100 LF of run length and at each change of direction. All structures shall be surveyed at corners of buildings. Locations and elevations shall be recorded on the Record Drawings. Submit drawings with QC certification. Submit drawings in AutoCAD format versions 2000 or 2002.

1.3 SPECIFICATION FOR DIGITAL DATA - GIS DELIVERABLES

Objective: The primary objective of this section is to provide detailed specifications for the collection and creation of Geographic Information

System (GIS) data to ensure that all GIS data delivered is compatible and will add value to Camp Lejeune's Installation Geospatial Information and Services (IGI&S) repository.

1.3.1 **Section 1** - Collection and Creation of Geospatial data

Prior to data collection and creation the contractor shall provide the Government Project Manager a Technical Approach Plan for approval which describes the contractor's plan to collect and create GIS Data as specified in this section.

The Technical Approach Plan will contain the following:

a. How features will be collected utilizing Global Positioning System (GPS) technology

b. Which features, as specified in Section 2, will be located, GPS and created

c. Source of attribute data

d. Steps taken to create file personal Geodatabase

e. What GIS data will be delivered

All questions regarding the Specification For Digital Data - GIS Deliverables shall be directed to MCB Camp Lejeune I&E, PWD GIS Section, via the Government Project Manager.

Specific Tasks are as follows:

a. Contractor is responsible for the collection and creation of geospatial data for newly constructed or replaced utilities and infrastructure features that fall within the realm of this specification.

b. Utilize GPS technology to locate and create GIS data and deliver only features that are relevant to this contract as specified in Section 2.

c. Follow instructions in Section 2 which defines the following:

(1) GIS feature requirements
(2) The manner in which the data will be collected in GPS
(3) The manner in which GIS data will be created
(4) Required Attribute data
(5) Other instructions pertaining to GIS data

Survey Grade and Sub-Foot GPS Geospatial Data Collection requirements:

a. GPS data shall be completed in accordance with the "Statewide Global Positioning System (GPS) Data Collection and Documentation Standards, Version 3" (or higher version if available at the time of this project) as prepared by the Statewide Mapping Advisory Committee and adopted by the North Carolina Geographic Coordinating Council in May 2006. Copies of these standards can be found on the Internet at: www.ncgicc.org.

b. Only bench marks included in the North Carolina Geodetic Survey

Base Station Network shall be used for mapping grade GPS data collection.

c. Mission planning is essential and contractor should utilize lowest possible PDOP values.

d. Geographic data shall be collected and created into the Universal Transverse Mercator (UTM) coordinate system.

(1) UTM Zone 18N, the GRS 1980 spheroid and the North American Datum 1983.

e. Spatial accuracy requirements for Survey and Sub-Foot grade data collection are as follows:

Sub-Foot requirements

(1) All points shall be within + 12 inches
(2) 95 % accuracy rate for all points.

Survey Grade requirements

(1) All points shall be within + 1 centimeter
(2) 98 % accuracy rate for all points

f. Every effort shall be made to capture feature locations without using offsets.

(1) Offsets will be noted in final report and user_flag field for which each feature it applies, unless otherwise specified

1.3.1.1 Geospatial Data Standards

The IGI&S repository model is based on the Spatial Data Standards for Facilities, Infrastructure and Environment (SDSFIE) with modifications.

a. Copies of the SDSFIE may be obtained from the Solutions and Technology for the Advancement and Refinement of SDSFIE (STARS) Team Internet homepage at http://www.sdsfie.org/.

b. Due to on-going government modifications to Camp Lejeune's IGI&S repository the contract shall ensure the schema of the final product is in compliance and all data will been created and delivered utilizing Camp Lejeune's most current IGI&S repository schema.

(1) The contractor shall request an additional template prior to delivery to be used for the final delivery of data

(2) Final report will include date of last data request for IGI&S schema and geospatial data

Camp Lejeune's IGI&S repository's schema and geospatial data shall be obtained via the Government Project Manager before any data is collected or created. The Project Manager, upon request, shall furnish the contractor with a Geospatial data request package. The contractor shall:

a. Request only GIS data that is pertinent to the contract

b. Request shall include the following information:

(1) Contract Number and Title
(2) Contractor's Name, Address, Phone Number, Email and Point of Contact
(3) Summary of Project
(4) Contract Specification
(5) Expected Delivery date and features

When developing a new feature class, the Contractor shall develop the initial structure consistent with the most current version of SDSFIE.

a. If further modifications to the database structure are required, the Contractor will consult with the Government Project Manager for direction and final approval.

b. All new feature data class shall be noted on the final report.

1.3.1.2 Collection of Geospatial data

a. Utility data, as identified in Section 2 will be collected utilizing Survey Grade GPS data collection methods.

b. Prior to GPS efforts, buried underground utilities shall be located in order to GPS accurate location.

c. Other infrastructure data, as identified in Section 2 shall be collected utilizing Sub-Foot GPS data collection methods.

d. GPS data and collection data files shall be included with every phase of delivery.

1.3.1.3 Creation of Geospatial Data

Data will be created in a File Personal Geodatabase using ArcGIS 9.3 or higher if a higher version is being used by the government at the time of this project.

Contractor shall verify the ArcGIS version, via the Government Project Manager, at the commencement of this contract.

Geodatabase Spatial Reference Properties shall include the following:

a. Coordinate System of UTM Zone 18N, the GRS 1980 spheroid and the North American Datum 1983

b. x,y domain precision of 1000

To ensure that all Geospatial data created can be loaded and add value to Camp Lejeune's IGI&S repository; data will be created in such a way that the delivered file personal geodatabase mirrors the IGI&S repository. This includes, but is not limited to the following:

a. Geospatial database table structure

b. Domain(s) configuration

(1) SDSFIE domains have been modified by Camp Lejeune for operational purposes, it is the contractor's responsibility to

request and utilize associated domain structure to ensure deliverable will load into the geodatabase

c. Required attribute data as specified in Section 2 shall be obtained via contract specifications, plans and on as-built drawings

(1) Actual field data always supersedes drawings

d. The contractor may have to research and verifying existing as-built data in the Technical Records Section located at the Public Works Building, MCB Camp Lejeune

All data must be created using GIS topology rules for polygons, points and lines, such as, but not limited to the following examples:

a. Polygons, Polylines and points rules, please reference illustrating topology rules in ArcGIS at www.esri.com

b. Polygons must not have slivers

c. All utility or infrastructure system data, which is, but not limited to, transportation system and electrical, water, steam distribution, and wastewater collection etc., will be created using GIS spatially connectivity rules which specifies that vertex, edge and endpoints be snapped to features within the system.

(1) Features will be snapped to the appropriate item

(2) Data will be created to represent the real world, for example, direction of flow, i.e., water, sewer and transportation systems will be drawn and created in the direction of flow

(3) Utility systems will be created from source to sink, etc

(4) Abandoned In Place (AIP) utility lines will be located and updated in the current utility line feature data set and identified as AIP in the attribute table

(4) Demolished Lines are to be delivered in a feature data set, which appropriately reflects the utility

1.3.1.4 Creation of Geographic Data Documentation (METADATA)

For each digital file delivered containing geographic information the Contractor shall provide documentation consistent with the Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata (CSDGM). Both 'Mandatory' and 'Mandatory-if- Applicable' fields shall be completed for each geographic data set.

Metadata generation tools included in the ArcGIS suite of software shall be used in the production of the required metadata in XML format. If neither of these tools is used, the Contractor must insure that the metadata is delivered in a format that can be easily translated to the XML format. Copies of the FGDC metadata standard can be obtained on the Internet at http://www.fgdc.gov.

The documentation shall include, but not be limited to, the following:

a. The name and description of the data set/data layer

b. The source of the data and any related data quality information such as positional accuracy and time period of content

c. Descriptions of the receiver and other equipment used during collection and processing, base stations used for differential corrections, software used for performing differential corrections, estimated horizontal and vertical accuracies obtained, and conversion routines used to translate the data into final geographic data delivery format

d. Type of data layer (point, line, polygon, etc.)

e. Field names of all attribute data and a description of each field name

f. Definition of all codes used in the data fields

g. Ranges of numeric fields and the meaning of these numeric ranges

h. The creation date of the data layer and the name of the person or company who created it

i. A point of contact shall be provided to answer technical questions

Final report will also be required with the following supplement information:

a. Specific procedures and list of equipment, software and versions that was utilized for the GPS data collection and creation of geospatial data

b. Any offsets

c. Modifications to the geodatabase to include any new feature data class

d. Source that was utilized for all required attributes

e. Miscellaneous information that the contractor deems significant

f. A Technical Point of Contact

g. GPS data controller files

1.3.1.5 GIS Submittals

a. Reports will be submitted in the following formats and or versions. Contractor shall verify version(s) of software, via the Government Project Manager, at the commencement of this contract

(1) Microsoft Office 2003
(2) Adobe Portable Document Format (PDF)
(3) Spreadsheet files shall be provided in Microsoft Excel format

b. All GIS data will be provided in a ArcGIS file personal geodatabase as specified

c. Media for Geospatial Data Deliverables: Geographic data shall be delivered on a compact disk read-only memory (CD-ROM) -or- digital versatile disk read-only memory (DVD-ROM)

d. Map submittals shall accompany each geospatial deliverable

(1) Include ANSI C map for each project / area

Data should be labeled and attributed per specification

1.3.1.6 Ownership

All digital files, final hard-copy products, source data acquired for this project, and related materials, including that furnished by the Government, shall become the property of Marine Corps Base, Camp Lejeune and will not be issued, distributed, or published by the Contractor.

1.3.1.7 Geographic Data Review

a. The digital geographic maps, GPS collection files and related data, all working text and documents and file personal geodatabase shall be included for review in the draft and final contract submittals

b. The contract shall submit a preliminary review of data between 15-25 percent to ensure specifications are being met

c. The data will be analyzed for discrepancies in subject content, correct format in accordance with these specifications, and compatibility with Camp Lejeune's IGI&S repository schema

d. Failure for non-compliance of the specifications outlined in this document will result in non-acceptance of data deliverables

1.3.2 **Section 2** - Instructions to GPS and Attribute Requirements

Contract shall deliver all GIS data required in this section that applies to this contract

a. Attribute data requirements for Infrastructure: The following attributes shall be collected for each infrastructure data class: Collect GPS data for all features listed with Sub-Foot accuracy and enter attribute data in compliance with the IGI&S repository

b. Structures: CLJN.structure_existing_area

GPS Structure and collect the following attributes:

(1) Subtype ID:
(2) Building ID:
(3) Structure Status
(4) Number of Levels
(5) Structure Use 2: Populate "Residential" if structure is a residential unit
(6) Material:
(7) Drawing Number
(8) Contract Number
(9) Date Acquired

(10) Source

c. Floor Outline: CLJN.building.floor_outline (Polyline) All new and renovated buildings will be required to have a "clean floor plan" for each floor level that will be delivered in GIS format. Each level will represent one feature and provide the following: walls, doors, windows, closet, crawlspace, head facility, stairwells, etc.

Create feature and update the following attributes:

(1) Building ID: Facility number
(2) Floor Name
(3) Subtype ID:
(4) Drawing Number
(5) Drawing Type
(6) Contract Number

d. Slabs: CLJN.slab_area

GPS and collect the following attributes:

(1) Structure ID: (Facility Number, if applicable)
(2) Feature Description:
(3) Structure Material
(4) Structure Condition
(5) Built Date
(6) Drawing Number
(7) Drawing Type
(8) Contract Number
(9) Data Source:

1.3.2.1 Attribute data requirements for Transportation

The following attributes shall be collected for each infrastructure data class: Collect GPS data for all features listed with Sub-Foot accuracy.

a. Road Centerline: CLJN.road_centerline

GPS and collect the following attributes:

(1) Category:
(2) Road Name
(3) Paved: PAVED / UNPAVED
(4) Date Acquired:
(5) Surface Type:
(6) Drawing Number
(7) Contract Number
(8) Data Source:
(9) Use:
(10) Ramp:

b. Road Area: CLJN.road_area

GPS and collect the following attributes:

(1) Road Segment
(2) Paved
(3) Divided: yes / no

(4) Number of Lanes
(5) Installation Date
(6) Surface Type: Drawing Number
(7) Contract Number
(8) Data Source:
(9) Road_Name
(10) Ramp:

c. Curb line: CLJN.curb_line

GPS and collect the following attributes:

(1) Curb Material
(2) Description
(3) Drawing Number
(4) Contract Number
(5) Data Source:

d. Driveways: CLJN.vehicle_driveway_area

GPS and collect the following attributes:

(1) Driveway ID: Building that is associated with this feature
(2) Paved or Unpaved:
(3) Surface Material
(4) Installation Date
(5) Drawing Number
(6) Contract Number
(7) Data Source:

e. Parking Lots: CLJN.vehicle_parking_area

GPS and collect the following attributes:

(1) Parking ID: Building that is associated with this feature
(2) Paved or Unpaved
(3) Total Spaces
(4) Lighting:
(5) Drawing Number
(6) Contract Number
(7) Data Source:
(8) Surface_Type:
(9) Vehicle_Day:
(10) Park_use:
(11) Feature Name:
(12) Striping:
(13) Vehicle_Type:

f. Bridge: CLJN.road_bridge_area

GPS and collect the following attributes:

(1) Bridge ID: Facility Number
(2) Number of Lanes
(3) Bridge Material Type
(4) Bridge Type
(5) Capacity:
(6) Drawing Number
(7) Drawing Type

(8) Contract Number
(9) Data Source:
(10) Feature Name:

g. Pedestrian Sidewalks: CLJN.pedestrian_sidewalk_area

GPS and collect the following attributes:

(1) Material
(2) Use:
(3) Status
(4) Drawing Number
(5) Contract Number
(6) Data Source:

1.3.2.2 Attribute data requirements for Improvement

The following attributes shall be collected for each infrastructure data class: Collect GPS data for all features listed with Sub-Foot accuracy.

a. Fence: CLJN.fence_line

GPS and collect the following attributes:

(1) Material: CHAIN LINK, WOOD, etc
(2) Drawing Number
(3) Contract Number
(4) Data Source:
(5) Length:

b. Gates: CLJN.gate_line

GPS and collect the following attributes:

(1) Material:
(2) Feature Height
(3) Drawing Number
(4) Contract Number
(5) Data Source:
(6) Length:

c. Walls: CLJN.wall_line

GPS and collect the following attributes:

(1) Material:
(2) Feature Height
(3) Drawing Number
(4) Contract Number
(5) Data Source:
(6) Length:

d. Recreation Trails: CLJN.recreation_trail_centerline

GPS and collect the following attributes:

(1) Subtype:
(2) Trail Description:
(3) Paved:

(4) Date Acquired:
(5) Drawing Number
(6) Contract Number
(7) Data Source:
(8) trail_id:
(9) Trail_Name:

e. Playground: CLJN.playground_area

GPS and collect the following attributes:

(1) Pool ID: Facility Number
(2) Feature Description:
(3) Drawing Number
(4) Contract Number
(5) Data Source:

f. Swimming Pool: CLJN.swimming_pool_area

GPS and collect the following attributes:

(1) Swimming Pool ID:
(2) Feature Description:
(3) Drawing Number
(4) Contract Number
(5) Data Source:

g. Athletic Court: CLJN.athletic_court_area

GPS and collect the following attributes:

(1) Court ID:
(2) Court Type:
(3) Court Name
(4) Date Acquired
(5) Drawing Number
(6) Contract Number
(7) Court Desc:

h. Athletic Field: CLJN.athletic_field_area

GPS Structures and collect the following attributes:

(1) Field ID: Facility Number
(2) Field Description:
(3) Date Acquired:
(4) Field Type
(5) Contract Number
(6) Drawing Number
(7) Data Source:
(8) Field Name

1.3.2.3 Environmental Storage Tanks

The following attributes shall be collected for each infrastructure data class: Collect GPS data for all features listed with survey grade accuracy.

a. Underground Storage Tanks: CLJN.underground_storage_tank_point

GPS and collect the following attributes:

(1) ENVUST-ID for Under Ground Storage Tank
(2) Hazsite_ID
(3) EH_Tank: Fuel Type
(4) Facility Number
(5) X Coordinates
(6) Y Coordinates
(7) Installation Date:
(8) Product_D:
(9) Narrative
(10) Serial Number
(11) Tank_Sys_D:
(12) Status:
(13) regulated:
(14) Volume
(15) Volume_U_D:

b. Aboveground Storage Tanks: CLJN.aboveground_storage_tank_site

GPS and collect the following attributes:

(1) ENVAST_ID for Above Ground Storage Tank
(2) Hazsite_ID
(3) EH_Tank:
(4) Facility Number
(5) X Coordinates
(6) Y Coordinates
(7) Product_D:
(8) Narrative
(9) Serial Number
(10) Tank_Sys_D:
(11) Status:
(12) Regulated:
(13) Volume
(14) Volume_U_D:

1.3.2.4 Other Features

a. Other Infrastructure Features:

All newly constructed features require GIS deliverables. If a particular utility is being installed and has been omitted from this specification, the feature shall be deliverable under these guidelines. At a minimum the following will be required:

(1) Subtype Id
(2) Facility ID
(3) Installation Date
(4) Type/Description
(5) Material
(6) Drawing Number
(7) Contract Number
(8) Data Source:

1.3.2.5 Utilities

Locate as specified in The Collections of Geospatial Data and Collect GPS

data for each feature listed with survey grade accuracy and enter Domain data in compliance with the IGI&S database

Please note: All utility lines that can be currently located in MCB, Camp Lejeune GIS geodatabase that are to be demolished/removed within the specifications of this contract will be used to update the demolished line feature data set for that class. The existing spatial and non-spatial data will be copied into the demolished feature class. This information does not include Abandoned in Place (AIP) lines. Abandoned lines shall remain the in the existing data feature class and be attributed AIP.

1.3.2.6 Electrical Distribution

Please Note: MCB, Camp Lejeune's Complete Circuit ID list is available, please contract Government Project Manager for list which is provided by our Electrical Distribution shop in Public Works, MCB Camp Lejeune.

The following attributes shall be collected for each utility data class:

a. Collect GPS data for all features listed with survey grade accuracy.

b. Demolished Electrical Lines: CLJN.demolished_cable_line

Existing attribute information will be copied into the demolished feature class: Please add the following attribute data once updated.

(1) Date
(2) Drawing Number
(3) Drawing Type
(4) Contract Number
(5) Data Source:

c. Electrical Lines: CLJN.electrical_cable_line

Locate all Electrical Line data and collect the following attributes:

(1) Subtype Identifier:
(2) Disposition:
(3) Subtype:
(4) Date Acquired:
(5) Conduit Size
(6) Number of Phases
(7) Insulation Material
(8) Voltage
(9) Size of Units
(10) Substation ID
(11) Circuit ID:
(12) Contract Number
(13) Drawing Number
(14) Data Source:

d. Electrical Meter: CLJN.electrical_meter_point

Locate, GPS and collect the following attributes:

(1) Meter ID

(2) Voltage
(3) KW Rate
(4) Number of Phases
(5) Model Number
(6) Date Acquired
(7) Facility ID
(8) Substation ID
(9) Circuit ID:
(10) X Coordinates
(11) Y Coordinates
(12) Contract Number
(13) Drawing Number
(14) Data Source:

e. Electrical Transformer: CLJN.elect_transformr_bank_point

Locate, GPS and collect the following attributes:

(1) Subtype:
(2) Date Installed
(3) Primary Voltage
(4) Secondary Voltage
(5) Number of Transformers
(6) Total KVA
(7) Substation ID
(8) Circuit ID:
(9) KVA Information
(10) X Coordinates
(11) Y Coordinates
(12) Contract Number
(13) Drawing Number
(14) Data Source:

f. Electrical Poles: CLJN.utility_pole_tower_point

Locate, GPS and collect the following attributes:

(1) Pole No
(2) Date Acquired:
(3) Condition
(4) Type:
(5) Material
(6) Pole Height
(7) Units of Measure
(8) Circuit ID
(9) X Coordinates
(10) Y Coordinates
(11) Contract Number
(12) Drawing Number
(13) Data Source:

g. Exterior Lighting: CLJN. exterior_lighting_point

Locate, GPS and collect the following attributes:

(1) Light Type
(2) X Coordinates
(3) Y Coordinates
(4) Sensor:

(5) Watts
(6) Voltage
(7) Circuit ID
(8) Contract Number
(9) Drawing Number
(10) Date Acquired:
(11) Data Source:

h. Electrical Switch: CLJN.electrical_switch_point

Locate, GPS and collect the following attributes:

(1) Subtype ID:
(2) Switch ID:
(3) Disposition
(4) Installation Type:
(5) Switch Status:
(6) Voltage
(7) Circuit ID:
(8) X Coordinates
(9) Y Coordinates
(10) Contract Number
(11) Drawing Number
(12) Data Source:

i. Electrical Regulator: CLJN.electrical_regulator_point

Locate, GPS and collect the following attributes:

(1) Electrical Regulator ID:
(2) Disposition
(3) Regulator Type
(4) Regulator Use
(5) Primary Volts
(6) Secondary Volts
(7) Number of Taps
(8) KV Rate
(9) Fuse Type
(10) Manufacture
(11) Model Number
(12) Circuit ID:
(13) X Coordinates
(14) Y Coordinates
(15) Contract Number
(16) Drawing Number
(17) Data Source:

j. Electrical Manholes: CLJN.electrical_junction_point

Locate, GPS and collect the following attributes:

(1) Subtype ID:
(2) Type:
(3) Number of Cables
(4) Rim Elevation
(5) Units of Elevation
(6) Diameter
(7) Diameter Units
(8) X Coordinates

(9) Y Coordinates
(10) Sub Station ID
(11) Contract Number
(12) Drawing Number
(13) Data Source:

k. Electrical Generators: CLJN.electrical_generator_point

Locate, GPS and collect the following attributes:

(1) Generator ID
(2) Disposition
(3) KVA
(4) KW Rate
(5) Voltage
(6) Fuel Type
(7) Manufacture
(8) Model
(9) Serial Number
(10) Circuit ID:
(11) X Coordinates
(12) Y Coordinates
(13) Facility ID
(14) Contract Number
(15) Drawing Number
(16) Data Source:

1.3.2.7 Substation

a. Substation: CLJN.CLJN.electrical_substation_point

Locate, GPS and collect the following attributes:

(1) Disposition
(2) Capacity Rate
(3) Capacity Measure
(4) Voltage In
(5) Voltage Out
(6) Number of transformer
(7) Number of Spares
(8) Number of Circuits
(9) X Coordinates
(10) Y Coordinates
(11) Contract Number
(12) Drawing Number
(13) Data Source
(14) Date Acquired

1.3.2.8 Steam Distribution

The following attributes shall be collected for each utility data class: Collect GPS data for all features listed with survey grade accuracy.

a. Boiler: CLJN.heat_cool_boiler_site - If Required

Locate, GPS and collect the following attributes:

(1) Date Acquired:
(2) Disposition

(3) Type
(4) Capacity Heat
(5) Capacity Units
(6) Building ID: Facility Number where Boiler Resides
(7) X Coordinates
(8) Y Coordinates
(9) Contract Number
(10) Drawing Number
(11) Data Source

b. Fitting: CLJN.heat_cool_fitting_point

Georeference fitting data and collect the following attributes:

(1) Subtype ID:
(2) Date Acquired:
(3) Material
(4) Size
(5) Units
(6) Line Diameter
(7) Diameter in Units
(8) X Coordinates
(9) Y Coordinates
(10) Contract Number
(11) Drawing Number
(12) Data Source:

c. Valves: CLJN.heat_cool_valve_point

Locate, GPS and collect the following attributes:

(1) Data Acquired
(2) Size
(3) Size Units
(4) Elevation
(5) Elevation Units
(6) Project ID
(7) X Coordinates
(8) Y Coordinates
(9) Contract Number
(10) Drawing Number
(11) Data Source:

d. Manholes: CLJN.heat_cool_junction_point

Locate, GPS and collect the following attributes:

(1) Sub Type ID:
(2) Number of Valves
(3) Number of Pipes
(4) Width
(5) Length
(6) Diameter
(7) Units for Measurements
(8) Rim Elevations
(9) Ground Elevation
(10) Contract Number
(11) Drawing Number
(12) X Coordinates

(13) Y Coordinates
(14) Data Source:

e. Steam Line: CLJN.heat_cool_line

Locate, GPS and collect the following attributes:

(1) Subtype ID: Condensate, Steam
(2) Date Acquired:
(3) Disposition
(4) Use Underground, Overhead, Abandoned
(5) Material
(6) Size
(7) Length
(8) Size Units
(9) Ground Elevation
(10) Invert Elevation
(11) Units for Elevation
(12) Taped: Yes/No
(13) Building ID - If service line indicate Building
(14) Insulation Material
(15) Size of Insulation
(16) Size Units
(17) Contract Number
(18) Drawing Number
(19) Data Source:

f. Demolished Steam Line: CLJN.demolished_heat_cool_line

Existing attribute information will be copied into the demolished feature class: Please add the following attribute data once updated.

(1) Date
(2) Drawing Number
(3) Drawing Type
(4) Contract Number
(5) Data Source:

1.3.2.9 Storm Sewer

a. Storm Sewer Lines: CLJN.storm_sewer_line

Locate, GPS and collect the following attributes:

(1) Date Acquired:
(2) Use
(3) Type
(4) Material
(5) Size
(6) Diameters Units
(7) Elevation
(8) Elevation Units
(9) Contract Number
(10) Drawing Type
(11) Drawing Number

b. Storm Sewer Drainage Line: CLJN.storm_sewer_open drainage_line

Locate, GPS and collect the following attributes:

(1) Date Acquired:
(2) Disposition
(3) Contract Number
(4) Drawing Type
(5) Drawing Number

c. Manhole: CLJN.storm_sewer_junction_point

Locate, GPS and collect the following attributes:

(1) Subtype
(2) X Coordinate
(3) Y Coordinates
(4) Contract Number
(5) Drawing Type
(6) Drawing Number

d. Inlet: CLJN.storm_sewer_inlet_point -

Locate, GPS and collect the following attributes: Contract shall verify SWPPP GPS inlet and add to this feature.

(1) Subtype
(2) Date Acquired
(3) X Coordinates
(4) Y Coordinates
(5) Contract Number
(6) Drawing Type
(7) Drawing Number

e. Outfall: CLJN.storm_sewer_outfall_point

Locate, GPS and collect the following attributes:

(1) Subtype Domain
(2) Date Acquired:
(3) Basin ID - contractor shall utilized existing data and coordinate Basin_ID with data manager
(4) User_Flag
(5) X Coordinates
(6) Y Coordinates
(7) Contract Number
(8) Drawing Type
(9) Drawing Number

f. Ponds, Basins, & Treatment Measures: CLJN.storm_sewer_reservoir_areas

Locate, GPS and collect the following attributes:

(1) Date Acquired:
(2) Project ID:
(3) Permit ID: SW8 XXXXXX
(4) Size:
(5) Facility ID:
(6) Installation ID:
(7) Drawing Type:

(8) Drawing Number:

1.3.2.10 Wastewater Collection

The following attributes shall be collected for each utility data class: Collect GPS data for all features listed with survey grade accuracy.

a. Wastewater Lines: CLJN.wastewater_line

Locate, GPS and collect the following attributes:

(1) Pipe ID: by Manhole number
(2) Date Acquired
(3) Use
(4) Material
(5) Size of Diameter
(6) Units
(7) Invert Elevation 1
(8) Invert Elevation 2
(9) Elevation Units
(10) Slope
(11) Slope Units:
(12) Building ID: If building/facility service line indicate Building number that the line services
(13) Contract Number
(14) Drawing Number
(15) Data Source:
(16) Subtype:

b. Demolished Lines: CLJN.demolished_wastewater_line

Existing attribute information will be copied into the demolished feature class: Please add the following attribute data once updated.

(1) Date
(2) Drawing Number
(3) Drawing Type
(4) Contract Number
(5) Data Source:

c. Fitting: CLJN.wastewater_fitting_point

Georeference Fitting data and collect the following attributes:

(1) Subtype ID:
(2) Date Acquired:
(3) Type
(4) Material
(5) Size of Diameter
(6) Units
(7) User Flag: Named Area
(8) Contract Number
(9) Drawing Number
(10) X Coordinates
(11) Y Coordinates
(12) Data Source:

d. Valves: CLJN.wastewater_valve_point

Locate, GPS and collect the following attributes:

(1) Valves ID: Manhole Number associate with valve
(2) Date Acquired:
(3) Valve Style/Group:
(4) Valve Use
(5) Size in Diameter
(6) Valve Elevation
(7) Units of Elevation
(8) X Coordinates
(9) Y Coordinates
(10) Manhole ID
(11) Contract Number
(12) Drawing Number
(13) Data Source:

e. Manholes: CLJN.wastewater_junction_point

Locate, GPS and collect the following attributes:

(1) Subtype ID: Manhole
(2) Manhole ID: Each section of the base has a unique numbering system for manholes; please see Public Work, GIS office for details.
(3) Use:
(4) Type
(5) Material
(6) Number of Pipes in manhole
(7) Rim Elevation
(8) Invert Elevation
(9) Elevations Units
(10) Manhole Diameter
(11) Diameter Units
(12) X Coordinates
(13) Y Coordinates
(14) Date Acquired:
(15) Contract Number
(16) Drawing Number
(17) Data Source:

f. Vent: CLJN.wastewater_vent_point

Locate, GPS and collect the following attributes:

(1) Date Acquired:
(2) Valve Style/Type:
(3) Use:
(4) Size in Diameters
(5) Units in Diameters
(6) X Coordinates
(7) Y Coordinates
(8) Subtype ID: AIR
(9) Containment Type
(10) Contract Number
(11) Drawing Number
(12) Data Source:

g. Pump Stations: CLJN.wastewater_pump_point

Locate, GPS and collect the following attributes:

(1) Pump Station ID: Facility Number
(2) Date Acquired
(3) Use
(4) Type
(5) Cooling Method
(6) Rated Outflow Volume
(7) Flow Unit Measure Code
(8) X Coordinates
(9) Y Coordinates
(10) Number of Pumps
(11) Contract Number
(12) Drawing Number
(13) Data Source

h. Oil Water Separators: CLJN.wstewat_oil_wat_separatr_point

Locate, GPS and collect the following attributes:

(1) Oil Water Separator ID: Facility Number
(2) Date Acquired
(3) Type
(4) Separator Process
(5) Separator Volume
(6) Volume Units of Measure
(7) Grit Chamber:
(8) Flow Capacity
(9) Flow Units
(10) X Coordinates
(11) Y Coordinates
(12) Contract Number
(13) Drawing Number
(14) Data Source

i. Grease Trap: CLJN.wastewater_grease_trap_point

Locate, GPS and collect the following attributes:

(1) Trap Identification: Nearest Facility use Number
(2) Type of Trap
(3) Material
(4) Capacity Units
(5) Manhole
(6) Total Number of Laterals
(7) Flow Rate
(8) Flow Units
(9) Building ID: Facility Number on associated Building
(10) X Coordinates
(11) Y Coordinates
(12) Contract Number
(13) Drawing Number
(14) Data Source:

j. Septic Tank: CLJN.CLJN.wastewater_septic_tank_point

Locate, GPS and collect the following attributes:

(1) Date Acquired:
(2) Disposition
(3) Tank Capacity
(4) Contract Number
(5) Drawing Number
(6) Data Source:

1.3.2.11 Water Distribution

The following attributes shall be collected for each utility data class: Collect GPS data for all features listed with survey grade accuracy.

a. Water Lines: CLJN.water_line

Locate, GPS and collect the following attributes:

(1) Date Acquired
(2) Use of Line
(3) Disposition
(4) Material
(5) Size
(6) Size Units
(7) Pipe Length
(8) Unit for Length Dimension
(9) Taped
(10) Source
(11) All Invert Elevation information
(12) Units of Measures
(13) Contract Number
(14) Drawing Number
(15) Data Source
(16) Subtype

b. Demolished Line: CLJN.demolished_water_line

Existing attribute information will be copied into the demolished feature class: Please add the following attribute data once updated.

(1) Date
(2) Drawing Number
(3) Drawing Type
(4) Contract Number
(5) Data Source: Existing GIS Data

c. Water Meter: CLJN.water_meter_point

Locate, GPS and collect the following attributes:

(1) Meter ID
(2) Date Acquired:
(3) Type
(4) Installation Type
(5) Building ID: Facility Number - If attached to Building
(6) X Coordinates
(7) Y Coordinates
(8) Contract Number
(9) Drawing Number
(10) Data Source

d. Water Tank: CLJN.water_tank_point

Locate, GPS and collect the following attributes:

(1) Tank ID: Facility Number
(2) Date Acquired
(3) Disposition
(4) Tank Use
(5) Tank Status
(6) Tank Width
(7) Tank Length
(8) Tank Diameter
(9) Ground Elevation
(10) Tank Volume
(11) Unit of measure in Gallons
(12) Top Elevation
(13) Overflow Elevation
(14) Pressure High
(15) Pressure Low
(16) X Coordinates
(17) Y Coordinates
(18) Contract Number
(19) Drawing Number
(20) Data Source:

e. Water Valve: CLJN.water_valve_point

Locate, GPS and collect the following attributes:

(1) Date Acquired:
(2) Disposition
(3) Use: Valve
(4) Valve Status
(5) Size
(6) Size Units
(7) Valve Elevation
(8) Ground Elevation
(9) Size Unit
(10) Manhole ID
(11) X Coordinates
(12) Y Coordinates
(13) Contract Number
(14) Drawing Number
(15) Data Source
(16) subtype

f. Water Fitting: CLJN.water_fitting_point

Georeference and collect the following attributes:

(1) Date Acquired
(2) Disposition
(3) Type
(4) Material
(5) Size
(6) Size Units
(7) Contract Number
(8) Drawing Number

(9) Data Source

g. Water Well: CLJN.potable_water_well_point

Locate, GPS and collect the following attributes:

(1) Well ID: Facility Number
(2) Use: potable
(3) Well Status
(4) Station ID: Building Number
(5) Date Acquired:
(6) X Coordinates
(7) Y Coordinates
(8) Tank ID: Water Tank Facility Number
(9) Contract Number
(10) Drawing Number
(11) Data Source:

h. Water Manhole: CLJN.water_junction_point

Locate, GPS and collect the following attributes:

(1) Subtype
(2) Use
(3) Type
(4) Material
(5) Number Valves
(6) Number Pipes
(7) Installation Date
(8) Size Diameter
(9) Unit Diameter
(10) X Coordinates
(11) Y Coordinates
(12) Contract Number
(13) Drawing Number
(14) Data Source:

i. Fire Hydrant: CLJN.water_fire_connection_point

Locate, GPS and collect the following attributes:

(1) Hydrant ID: TBD by Fire Department
(2) Date Acquired:
(3) Disposition
(4) Valve Connector Type
(5) Valve Size:
(6) Inlet Diameter
(7) Units of measure
(8) X Coordinates
(9) Y Coordinates
(10) Contract Number
(11) Drawing Number
(12) Data Source:

j. NON Potable Water Well: CLJN.non-potable_water_well_point

Locate, GPS and collect the following attributes:

(1) Well ID: Facility Number

(2) Use:
(3) Well Status
(4) Station ID: Building Number
(5) Date Acquired:
(6) X Coordinates
(7) Y Coordinates
(8) Tank ID: Water Tank Facility Number
(9) Contract Number
(10) Drawing Number
(11) Data Source:

k. Other Utility Features:Failure to follow the specification outlined in this document will result in non-acceptance of data deliverable.

Geospatial data delivery does not replace as-built requirements

All newly constructed features require GIS deliverables.

(1) Facility ID
(2) Installation Date
(3) Type/Description
(4) Material
(5) Size
(6) Drawing Number
(7) Contract Number
(8) Data Source

1.3.2.12 Non-Compliance

Failure to follow the specification outlined in this document will result in non-acceptance of data deliverable.

Geospatial data delivery does not replace as-built requirements.

1.3.3 As-Built Record of Materials

Furnish a record of materials.

Where several manufacturers' brands, types, or classes of the item listed have been used in the project, designate specific areas where each item was used. Designations shall be keyed to the areas and spaces depicted on the contract drawing. Furnish the record of materials used in the following format:

MATERIALS DESIGNATION	SPECIFICATION	MANUFACTURER	MATERIALS USED (MANUFACTURER'S DESIGNATION)	WHERE USED
_____	_____	_____	_____	_____

1.3.4 Maximo Requirements

Submit maximo requirements as specified in Section 23 03 00 and 26 00 00.

1.4 EQUIPMENT/PRODUCT WARRANTIES

1.4.1 Equipment/Product Warranty List

Furnish to the Contracting Officer a bound and indexed notebook containing written warranties for equipment/products that have extended warranties (warranty periods exceeding the standard one-year warranty) furnished under the contract, and prepare a complete listing of such equipment/products. The equipment/products list shall state the specification section applicable to the equipment/product, duration of the warranty therefor, start date of the warranty, ending date of the warranty, and the point of contact for fulfillment of the warranty. The warranty period shall begin on the same date as project acceptance and shall continue for the full product warranty period. Execute the full list and deliver to the Contracting Officer prior to final acceptance of the facility.

1.4.2 Equipment Warranty Tags and Guarantor's Local Representative

Furnish with each warranty the name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and appliances are installed. The guarantor's representative, upon request of the station representative, shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty. At the time of installation, tag each item of warranted equipment with a durable, oil- and water-resistant tag approved by the Contracting Officer. Attach tag with copper wire and spray with a clear silicone waterproof coating. Leave the date of acceptance and QC's signature blank until project is accepted for beneficial occupancy. Tag shall show the following information:

EQUIPMENT/PRODUCT WARRANTY TAG

Type of Equipment/Product _____
Warranty Period _____ From _____ To _____
Contract No. _____
Inspector's Signature _____ Date Accepted _____

Construction Contractor:
Name: _____
Address: _____
Telephone: _____

Warranty Contact: _____
Name: _____
Address: _____
Telephone: _____

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

1.5 COMPLETE SUBMITTAL PACKAGE

Contractor shall make electronic copies of all submittals, including the transmittal sheet, and provide a CD/DVD containing all submittals for project close out.

The CD/DVD shall be marked "Complete Submittal Package - Contract #_____."

1.6 MECHANICAL TESTING AND BALANCING

All contract requirements of Section 23 09 53.00 20, "Space Temperature Control Systems," 23 09 54, "Direct Digital Control Systems," shall be fully completed, including all testing, prior to contract completion date. In addition, all contract requirements of Section 23 08 00.00 20, "HVAC Testing/Adjusting/Balancing," shall be fully completed, including testing and inspection, prior to contract completion date, except as noted otherwise in Section 23 08 00.00 20. The time required to complete all work and testing as prescribed by Sections 23 09 53.00 20, 23 09 54, and 23 08 00.00 20 is included in the allotted calendar days for completion.

1.7 CLEANUP

Leave premises "broom clean." Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean filters of operating equipment. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 02 41 00

DEMOLITION

10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K	(2005) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2004) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE/SAFE A10.6	(2006) Safety Requirements for Demolition Operations

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(2002) Standard for Installation Specification of Commercial Carpet

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety -- Safety and Health Requirements

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25	(June 2000) Storage and Handling of Liquefied and Gaseous Compressed Gases and Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M	(2006; Notice 1) Requisitioning and Issue Procedures

MIL-STD-129	(Rev P; Notice 3; Change 4) Military Marking for Shipment and Storage

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev K) Obstruction Marking and Lighting

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 173.301	Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.2 GENERAL REQUIREMENTS

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the station daily, project site; do not allow accumulations inside or outside the buildings, on airfield pavements. The work includes demolition, deconstruction, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-07 Certificates

Demolition Plan
Notifications
Notification of Demolition and Renovation forms

Proposed salvage, demolition, and removal procedures for approval before work is started.

SD-11 Closeout Submittals

Receipts

Receipts or bills of lading, as specified.

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In

addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6.

1.4.1 Notifications

1.4.1.1 General Requirements

Furnish timely notification of demolition, deconstruction, and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA), State's environmental protection agency, local air pollution control district/agency, and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M.

1.4.2 Receipts

Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to occupied portions of the building on airfield pavements and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where pedestrian and driver, aircraft safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind, jet or prop blast. Notify the Contracting Officer prior to beginning such work.

Contractor must provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet 30 meter above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

1.6.2 Existing Conditions Documentation

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of

surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document.

1.6.3 Items to Remain in Place

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements, pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.6.4 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from work areas daily.

1.6.5 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.6.6 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.6.7 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor, the Government will disconnect and seal utilities serving each area of alteration or removal upon written request from the Contractor.

1.6.8 Facilities

Protect electrical and mechanical services and utilities. Where removal of

existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.6.9 Protection of Personnel

Before, during and after the demolition and deconstruction work the Contractor shall continuously evaluate the condition of the structure being demolished and deconstructed and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield pavements. Remove all such materials that may appear on operational aircraft pavements due to the Contractor's operations. If necessary, the Contracting Officer may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. The barricade must include a fence covered with a fabric designed to stop the spread of debris. Anchor the fence and fabric to prevent displacement by winds or jet/prop blasts. Remove barricade when no longer required.

1.9 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Contracting Officer.

1.10 REQUIRED DATA

Prepare a Demolition Plan, Deconstruction Plan. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and airfield lighting, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste

Management Plan. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Structural PE, Contracting Officer prior to work beginning.

1.11 ENVIRONMENTAL PROTECTION

Comply with the Environmental Protection Agency requirements specified.

1.12 USE OF EXPLOSIVES

Use of explosives will no be permitted.

PART 2 PRODUCTS

2.1 FILL MATERIAL

Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or deconstruction of structures. Fill material shall be waste products from demolition or deconstruction until all waste appropriate for this purpose is consumed.

Fill material must conform to the definition of satisfactory soil material as defined in AASHTO M 145, Soil Classification Groups A-1, A-2-4, A-2-5 and A-3. In addition, fill material must be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

Proposed fill material must be sampled and tested by an approved soil testing laboratory, as follows:

Soil classification	AASHTO M 145
Moisture-density relations	AASHTO T 180, Method B or D

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures on site for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse on site whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to be removed to 10 feet below grade. Interior walls, other than retaining walls and partitions, shall be removed to 2 feet below grade or to top of concrete slab on ground. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated.

b. Demolish structures in a systematic manner from the top of the

structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Contracting Officer.

c. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location on the station in accordance with instructions of the Contracting Officer.

3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas.

3.1.4 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs as indicated to a depth of 24 inches below existing adjacent grade. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.5 Roofing

Remove existing roof system and associated components in their entirety down to existing roof deck. Remove built-up, single-ply roofing to effect the connections with new flashing or roofing. Remove gravel surfacing from existing roofing felts for a minimum distance of 18 inches back from the cut. Remove gravel without damaging felts. Cut existing felts, membrane, and insulation along straight lines. Remove roofing system and insulation without damaging the roof deck. Sequence work to minimize building exposure between demolition or deconstruction and new roof materials installation.

3.1.5.1 Temporary Roofing

Install temporary roofing and flashing as necessary to maintain a watertight condition throughout the course of the work. Remove temporary work prior to installation of permanent roof system materials unless approved otherwise by the Contracting Officer. The existing deck and support structure is deteriorated where indicated, such that ability to support foot traffic and construction loads is unknown. Make provisions for worker safety during demolition, deconstruction, and installation of new materials as described in paragraphs entitled "Statements" and "Regulatory and Safety Requirements."

3.1.5.2 Reroofing

When removing the existing roofing system from the roof deck, remove only as much roofing as can be recovered by the end of the work day, unless approved otherwise by the Contracting Officer. Do not attempt to open the roof covering system in threatening weather. Reseal all openings prior to suspension of work the same day.

3.1.6 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain, to removed materials being salvaged and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated, specified for the new work. Provide square, straight edges and corners where existing masonry adjoins new work and other locations. Masonry removed in whole blocks shall be salvaged and stored for reuse. Masonry removed in pieces shall be crushed for use as aggregate.

3.1.7 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Salvage removed concrete.

3.1.8 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for reuse, recycle, structural steel, steel joists, girders, angles, plates, columns and shapes. Do not use flame-cutting torches, Flame-cutting torches are permitted when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled. Transport structural steel shapes to a designated storage area, recycling facility area as directed by the Contracting Officer, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.9 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal

gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.10 Carpentry

Salvage for reuse, recycle, lumber, millwork items, and finished boards, and sort by type and size. Chip or shred and recycle salvaged wood unfit for reuse, except stained, painted, or treated wood. Salvage, Remove windows, doors, frames, and cabinets, and similar items as whole units, complete with trim and accessories. Do not remove hardware attached to units, except for door closers. Salvage hardware attached to units for reuse. Brace the open end of door frames to prevent damage.

3.1.11 Carpet

Remove existing carpet for reclamation in accordance with manufacturer recommendations and as follows. Remove used carpet in large pieces, roll tightly, and pack neatly in a container. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Adhesive removal solvents shall comply with CRI 104. Recycle removed carpet cushion.

3.1.12 Acoustic Ceiling Tile

Remove, neatly stack, and recycle acoustic ceiling tiles. Recycling may be available with manufacturer. Otherwise, priority shall be given to a local recycling organization.

3.1.13 Airfield Lighting

Remove existing airfield lighting as indicated and terminate in a manner satisfactory to the Contracting Officer. Remove edge lights, associated transformers and as indicated and deliver to a location on the station in accordance with instructions of the Contracting Officer. ispose of off station..

3.1.14 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor

tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.1.15 Air Conditioning Equipment

Remove air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

3.1.16 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.17 Locksets on Swinging Doors

The Contractor shall remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the Contracting Officer after removal.

3.1.18 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Mechanical equipment and fixtures must be disconnected at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated on station storage area as directed by the Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse; provide to recycling service for disassembly and recycling of parts.

3.1.18.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, must be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.18.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges,

or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.18.3 Ducts

Classify removed duct work as scrap metal.

3.1.18.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify non-porcelain broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris to be disposed of by the Contractor. Salvage and crush porcelain plumbing fixtures unsuitable for reuse.

3.1.19 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.19.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.19.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.19.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.19.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and

undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.20 Elevators and Hoists

Remove elevators, hoists, and similar conveying equipment and salvage as whole units, to the most practical extent. Remove and prepare items for salvage without damage to any of the various parts. Salvage and store rails for structural steel with the equipment as an integral part of the unit.

3.1.21 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or deconstruction work in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Reuse of Materials and Equipment

Remove and store materials and equipment listed in the Demolition, Deconstruction Plan, indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3.3 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition, Deconstruction Plan indicated and specified to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site, as directed within specified miles of the work site.

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the

Contracting Officer and remove from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. Deliver the following items reserved as property of the Government to the areas designated: _____.

d. Remove the following items reserved as property of the using service prior to commencement of work under this contract: _____.

e. Remove historical items in a manner to prevent damage. Deliver the following historical items to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

f. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the Navy as directed by the Commanding Officer. by shipping the refrigerant container to the Defense Logistics Agency at the following address:

Defense Depot Richmond VA (DDVA)
SW0400
Cylinder Operations
800 Jefferson Davis Highway
Richmond, VA 23297-5000

The Government will remove and capture Class I ODS refrigerants.

3.3.4 Debris Disposal in the San Diego Area

Landfill coupons, that permit waste disposal at the Miramar Landfill free of charge, are available from the Contracting Officer. The coupons will be issued only upon the submission of a written request, by the prime contractor to the ROICC, which must identify the nature of the waste and the number of coupons requested. The landfill coupons issued under this contract are to be used only for the disposal of waste generated by this contract. If the prime contractor, one of its subcontractors, or one of its waste haulers is found to be misusing the landfill coupons by disposing of waste not generated under this contract, all rights under the contract to use landfill coupons shall be forfeited, from the date of misuse forward. All unused coupons will be returned to the Contracting Officer and no additional coupons will be issued for the duration of the contract. The Contracting Officer's refusal to issue landfill coupons, because of prior misuse, is not a change to the contract and no adjustment of the contract price will be made.

3.3.5 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting ARI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be put back into the existing equipment, turned over to the Contracting Officer, removed from

Government property and disposed of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.3.5.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of shipment

e. Naval stock number (for information, call (804) 279-4525).

3.3.5.2 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.6 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.7 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the disposal area located. The fill in the disposal area must remain below specified elevation and after disposal is completed, the disposal area must be uniformly graded to drain. Dispose of unsalvageable and non-recyclable combustible material in the sanitary fill area located as indicated off the site, by burning.

3.4 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified off the _____ center, in the

Waste Management Plan. Storage of removed materials on the project site is prohibited.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property, Transport combustible materials removed from demolished and deconstructed structures to the areas designated for burning. Control fires for protection of persons and property. Monitor fires continuously until the fires have burned out or have been extinguished. Comply with Federal, State and local laws regulating the building and maintaining of brush and trash fires.

3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

3.5.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.6 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

SECTION 02 81 00

TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the ations are referenced in the text by basic designation only.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

IATA DGR	(2004) Dangerous Goods Regulations

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

DOT 4500.9R	Defense Transportation Regulation, PArt 2, Cargo Movement, Chapter 204, Hazardous Material

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 279	Standards for the Management of Used Oil
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan

40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.2 DEFINITIONS

1.2.1 Hazardous Material

A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801 et seq. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections .101 and .102 and materials which meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.

1.2.2 Hazardous Waste

A waste which meets criteria established in RCRA or specified by the EPA in 40 CFR 261 or which has been designated as hazardous by a RCRA authorized state program.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

On-site Hazardous Waste Management

Prior to start of work, a plan detailing the manner in which hazardous wastes shall be managed. Written documentation of weekly hazardous waste inspections shall be submitted on a monthly, _____ basis.

Notices of Non-Compliance and Notices of Violation

Notices of non-compliance or notices of violation, as specified.

SD-06 Test Reports

Recordkeeping

Information necessary to file state annual or EPA biennial reports for all hazardous waste transported, treated, stored, or disposed of under this contract. The Contractor shall not forward these data directly to the regulatory agency but to the Contracting Officer at the specified time. The submittal shall contain all the information necessary for filing of the formal reports in the form and format required by the governing Federal or state regulatory agency. A cover letter shall accompany the data to include the contract number, Contractor name, and project location.

Spill Response

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), or pollutant or contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), the Contractor shall notify the Contracting Officer immediately. If the spill exceeds a reporting threshold, the Contractor shall follow the pre-established procedures for immediate reporting to the Contracting Officer.

Exception Reports

In the event that a manifest copy documenting receipt of hazardous waste at the treatment, storage, and disposal facility is not received within 35 days of shipment initiation, the Contractor shall prepare and submit an exception report to the Contracting Officer within 37 days of shipment initiation. In the event that a manifest copy documenting receipt of PCB waste at the designated facility is not received within 35 days of shipment initiation, the Contractor shall prepare and submit an exception report to the Contracting Officer within 37 days of shipment initiation.

Packaging Notifications

In accordance with 49 CFR 178.2(c), the Contractor shall acquire the appropriate notifications from the package manufacturers or any other persons certifying compliance with the packaging provisions and provide these to the Government.

SD-07 Certificates

Certification

Copies of the current certificates of registration required by 49 CFR 107, Subpart G issued to the Contractor and/or subContractors or written statements certifying exemption from these requirements.

Security Plan

Pre-transportation security plan, as specified.

Transportation and Disposal Coordinator

Transportation and Disposal Coordinator qualifications including proof of at least one year specialized experience in management and transportation of hazardous wastes; proof of current Department of Transportation Hazardous Materials Training Certification; and, where applicable, proof of IATA DGR.

Training

Documentation that employees preparing or transporting hazardous materials have been trained, tested, and certified per 49 CFR 172, Subpart H, including general security awareness requirements and where applicable, site-specific security plan requirements.

EPA Off-Site Policy

A letter certifying that EPA considers the facilities to be used for all off-site disposal to be acceptable in accordance with the Off-Site policy in 40 CFR 300, Section .440. This certification shall be provided for wastes from Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901 et seq., sites as well as from Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. 9601 et seq., responses. See Attachment A, sample certification, at the end of this section.

Certificates of Disposal

Certificates documenting the ultimate disposal, destruction or placement of hazardous wastes, CERCLA remediation waste, polychlorinated biphenyls (PCBs), PCB ballasts, light bulbs, mechanical swithces, thermostats, lead chips, mercury, and/or asbestos, within 180, _____ days of initial shipment. Receipt of these certificates will be required for final payment.

Shipping Documents and Packagings Certification

All transportation related shipping documents to the Contracting Officer, including draft hazardous waste manifests, draft land disposal restriction notifications, draft asbestos waste shipment records draft manifests for PCBs, draft bill of ladings for hazardous materials, lists of corresponding proposed labels, packages, marks, and placards to be used for shipment, waste profiles, supporting waste analysis documents, for review a minimum of 14, _____ days prior to anticipated pickup. Packaging assurances shall be furnished prior to transporting hazardous material; "generator copies" of hazardous waste manifests, land disposal restriction notifications, asbestos waste shipment records, "generator copies" of manifests used for initiating shipments of PCBs, used oil invoices/shipment records, bill of ladings, supporting waste analysis documents shall be furnished when shipments are originated; and "receipt copies" of hazardous waste manifests, PCB manifests and asbestos waste shipment records at the designated disposal facility shall be furnished not later than 35 days after acceptance of the shipment.

Waste Minimization

Written certification that waste minimization efforts have been

undertaken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

1.4 QUALIFICATIONS

1.4.1 Transportation and Disposal Coordinator

The Contractor shall designate, by position and title, one person to act as the Transportation and Disposal Coordinator (TDC) for this contract. The TDC shall serve as the single point of contact for all environmental regulatory matters and shall have overall responsibility for total environmental compliance at the site including, but not limited to, accurate identification and classification of hazardous waste and hazardous materials; determination of proper shipping names; identification of marking, labeling, packaging and placarding requirements; completion of waste profiles, hazardous waste manifests, asbestos waste shipment records, PCB manifests, bill of ladings, exception and discrepancy reports; and all other environmental documentation. The TDC shall have, at a minimum, one year of specialized experience in the management and transportation of hazardous waste and have been Department of Transportation certified under 49 CFR 172, Subpart H.

1.4.2 Training

The Contractor's hazardous materials employees shall be trained, tested, and certified to safely and effectively carry out their assigned duties in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.. The Contractor's employees transporting hazardous materials or preparing hazardous materials for transportation, including samples, shall be trained, tested, and certified in accordance with 49 CFR 172, Subpart H, including security awareness and any applicable security plans. Where shipment of hazardous materials by air may be occurring, such as for sample shipments, the Contractor's hazardous material employees shall also be trained on IATA DGR. Contractor employees making determinations that shipments do not constitute DOT regulated hazardous materials shall also be trained, tested, and certified in accordance with 49 CFR 172, Subpart H.

1.4.3 Certification

The Contractor and/or subContractors transporting hazardous materials shall possess a current certificate of registration issued by the Research and Special Programs Administration (RSPA), U.S. Department of Transportation, when required by 49 CFR 107, Subpart G.

1.5 LAWS AND REGULATIONS REQUIREMENTS

Work shall meet or exceed the minimum requirements established by Federal, state, and local laws and regulations which are applicable. These requirements are amended frequently and the Contractor shall be responsible for complying with amendments as they become effective. In the event that compliance exceeds the scope of work or conflicts with specific requirements of the contract, the Contractor shall notify the Contracting Officer immediately.

PART 2 PRODUCTS

2.1 MATERIALS

The Contractor shall provide all of the materials required for the packaging, labeling, marking, placarding and transportation of hazardous wastes and hazardous materials in conformance with Department of Transportation standards and IATA DGR and USACE EP 415-1-266. Details in this specification shall not be construed as establishing the limits of the Contractor's responsibility.

2.1.1 Packagings

The Contractor shall provide bulk, non-bulk, bulk and non-bulk, containers for packaging hazardous materials/wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 8. Bulk and non-bulk packaging shall meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172, Section .101. Each packaging shall conform to the general packaging requirements of Subpart B of 49 CFR 173, to the requirements of 49 CFR 178 at the specified packing group performance level, to the requirements of special provisions of column 7 of the Hazardous Materials Table in 49 CFR 172, Section .101, and shall be compatible with the material to be packaged as required by 40 CFR 262. The Contractor shall also provide other packaging related materials such as materials used to cushion or fill voids in overpacked containers, etc. Sorbent materials shall not be capable of reacting dangerously with, being decomposed by, or being ignited by the hazardous materials being packaged. Additionally, sorbents used to treat free liquids to be disposed of in landfills shall be non-biodegradable as specified in 40 CFR 264, Section .314. In addition, packaging notifications will be provided to the Government per 49 CFR 172, Section .178.2(c) regarding type and dimensions of closures, including gaskets, needed to satisfy performance test requirements.

2.1.2 Markings

The Contractor shall provide markings for each hazardous material/waste package, freight container, and transport vehicle consistent with the requirements of 49 CFR 172, Subpart D and 40 CFR 262, Section .32 (for hazardous waste), 40 CFR 761, Section .45 (for PCBs), 40 CFR 61, Section .149(d) (for asbestos), USACE EP 415-1-266 (for FUSRAP radionuclides). Markings shall be capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.1.3 Labeling

The Contractor shall provide primary and subsidiary labels for hazardous materials/wastes consistent with the requirements in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 6. Labels shall meet design specifications required by 49 CFR 172, Subpart E including size, shape, color, printing, and symbol requirements. Labels shall be durable and weather resistant and capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.1.4 Placards

For each off-site shipment of hazardous material/waste, the Contractor

shall provide primary and subsidiary placards consistent with the requirements of 49 CFR 172, Subpart F. Placards shall be provided for each side and each end of bulk packaging, freight containers, transport vehicles, and rail cars requiring such placarding. Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30 day exposure to open weather conditions and shall meet design requirements specified in 49 CFR 172, Subpart F.

2.1.5 Spill Response Materials

The Contractor shall provide spill response materials including, but not limited to, containers, adsorbent, shovels, and personal protective equipment. Spill response materials shall be available at all times in which hazardous materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of material being handled.

2.2 EQUIPMENT AND TOOLS

The Contractor shall provide miscellaneous equipment and tools necessary to handle hazardous materials and hazardous wastes in a safe and environmentally sound manner.

PART 3 EXECUTION

3.1 ON-SITE HAZARDOUS WASTE MANAGEMENT

These paragraphs apply to Government owned waste only. Contractors are prohibited by 10 U.S.C. 2692 from storing Contractor owned waste on site for any length of time. The Contractor shall be responsible for ensuring compliance with all Federal, state, and local hazardous waste laws and regulations and shall verify those requirements when preparing reports, waste shipment records, hazardous waste manifests, or other documents. The Contractor shall identify hazardous wastes using criteria set forth in 40 CFR 261 or all applicable state and local laws, regulations, and ordinances. When accumulating hazardous waste on-site, the Contractor shall comply with generator requirements in 40 CFR 262 and any applicable state or local law or regulations. On-site accumulation times shall be restricted to applicable time frames referenced in 40 CFR 262, Section .34 and any applicable state or local law or regulation. Accumulation start dates shall commence when waste is first generated (i.e. containerized or otherwise collected for discard). The Contractor shall only use containers in good condition and compatible with the waste to be stored. The Contractor shall be responsible for ensuring containers are closed except when adding or removing waste. The Contractor shall be responsible for immediately marking all hazardous waste containers with the words "hazardous waste" and other information required by 40 CFR 262, Section .32 and any applicable state or local law or regulation as soon as the waste is containerized. An additional marking shall be placed on containers of "unknowns" designating the date sampled, and the suspected hazard. The Contractor shall be responsible for inspecting containers for signs of deterioration and shall be responsible for responding to any spills or leaks. The Contractor shall inspect all hazardous waste areas weekly and shall provide written documentation of the inspection. Inspection logs shall contain date and time of inspection, name of individual conducting the inspection, problems noted, and corrective actions taken.

3.1.1 Hazardous Waste Classification

The Contractor, in consultation with the Contracting Officer waste generator, shall identify all waste codes applicable to each hazardous waste stream based on requirements in 40 CFR 261 or any applicable state or local law or regulation. The Contractor shall also identify all applicable treatment standards in 40 CFR 268 and state land disposal restrictions and shall make a determination as to whether or not the waste meets or exceeds the standards. Waste profiles, analyses, classification and treatment standards information shall be submitted to Contracting Officer for review and approval.

3.1.2 Management Plan

The Contractor shall prepare a plan detailing the manner in which hazardous wastes will be managed and describing the types and volumes of hazardous wastes anticipated to be managed as well as the management practices to be utilized. The plan shall identify the method to be used to ensure accurate piece counts and/or weights of shipments; shall identify waste minimization methods; shall propose facilities to be utilized for treatment, storage, and/or disposal; shall identify areas on-site where hazardous wastes are to be handled; shall identify whether transfer facilities are to be utilized; and if so, how the wastes will be tracked to ultimate disposal.

3.2 OFF-SITE HAZARDOUS WASTE MANAGEMENT

The Contractor shall use RCRA Subtitle C permitted facilities which meet the requirements of 40 CFR 264 or facilities operating under interim status which meet the requirements of 40 CFR 265. Off-site treatment, storage, and/or disposal facilities with significant RCRA violations or compliance problems (such as facilities known to be releasing hazardous constituents into ground water, surface water, soil, or air) shall not be used. The Contractor shall submit Notices of Non-Compliance and Notices of Violation by a Federal, state, or local regulatory agency issued to the Contractor in relation to any work performed under this contract. The Contractor shall immediately provide copies of such notices to the Contracting Officer. The Contractor shall also furnish all relevant documents regarding the incident and any information requested by the Contracting Officer, and shall coordinate its response to the notice with the Contracting Officer or his designated representative prior to submission to the notifying authority. The Contractor shall also furnish a copy to the Contracting Officer of all documents submitted to the regulatory authority, including the final reply to the notice, and all other materials, until the matter is resolved.

3.2.1 Treatment, Storage, and/or Disposal Facility and Transporter

The Contractor shall provide the Contracting Officer with EPA ID numbers, names, locations, and telephone numbers of TSD facilities and transporters. This information shall be contained in the Hazardous Waste Management Plan and shall be approved by the Contracting Officer prior to waste disposal.

3.2.2 Status of the Facility

Facilities receiving hazardous waste must be permitted in accordance with 40 CFR 270 or operating under interim status in accordance with 40 CFR 265 requirements, or must be permitted by a state authorized by the Environmental Protection Agency to administer the RCRA permit program. Additionally, prior to using a TSD Facility, the Contractor shall contact

the EPA Regional Off-site Coordinator specified in 40 CFR 300, Section .440, to determine the facility's status, and document all information necessary to satisfy the requirements of the EPA Off-Site policy and furnish this information to the Contracting Officer.

3.2.3 Shipping Documents and Packagings Certification

Prior to shipment of any hazardous material off-site, the Contractor's TDC shall provide written certification to the Contracting Officer that hazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation and EPA requirements. The Contractor's TDC shall also provide written certification regarding waste minimization efforts documenting that efforts have been taken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.2.4 Transportation

Prior to conducting hazardous materials activities, the Contractor responsible for pre-transportation activities shall either certify to the Government that a Security Plan is in place which meets the requirements of 49 CFR 172, Subpart I or in the event that the types or amounts of hazardous materials are excluded from the security planning requirements, a written statement to that effect detailing the basis for the exception. The Contractor shall use manifests for transporting hazardous wastes as required by 40 CFR 263 or any applicable state or local law or regulation. Transportation shall comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series. The Contractor shall prepare hazardous waste manifests for each shipment of hazardous waste shipped off-site. Manifests shall be completed using instructions in 40 CFR 262, Subpart B and any applicable state or local law or regulation. Manifests and waste profiles shall be submitted to Contracting Officer for review and approval. The Contractor shall prepare land disposal restriction notifications as required by 40 CFR 268 or any applicable state or local law or regulation for each shipment of hazardous waste. Notifications shall be submitted with the manifest to the Contracting Officer for review and approval. In accordance with DOT 4500.9R, the Contractor shall inspect motor vehicles used to transport hazardous materials in accordance the 49 CFR and DOT safety regulations and shall complete DDForm 626, Motor Vehicle Inspection.

3.2.5 Treatment and Disposal of Hazardous Wastes

The hazardous waste shall be transported to an approved hazardous waste treatment, storage, or disposal facility within 90 days of the accumulation start date on each container. The Contractor shall ship hazardous wastes only to facilities which are properly permitted to accept the hazardous waste or operating under interim status. The Contractor shall ensure wastes are treated to meet land disposal treatment standards in 40 CFR 268 prior to land disposal. The Contractor shall propose TSD facilities via submission of the Hazardous Waste Management Plan, subject to the approval of the Contracting Officer. The Contractor shall submit Certificates of Disposal as specified in the Submittals paragraph.

3.3 HAZARDOUS MATERIALS MANAGEMENT

The Contractor, in consultation with the Contracting Officer generator, shall evaluate, prior to shipment of any material off-site, whether the

material is regulated as a hazardous waste in addition to being regulated as a hazardous material; this shall be done for the purpose of determining proper shipping descriptions, marking requirements, etc., as described below.

3.3.1 Identification of Proper Shipping Names

The Contractor shall use 49 CFR 172, Section .101 to identify proper shipping names for each hazardous material (including hazardous wastes) to be shipped off-site. Proper shipping names shall be submitted to the Contracting Officer in the form of draft shipping documents for review and approval.

3.3.2 Packaging, Labeling, and Marking

The Contractor shall package, label, and mark hazardous materials/wastes using the specified materials and in accordance with the referenced authorizations. The Contractor shall mark each container of hazardous waste of 110 gallons or less with the following:

"HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal.
If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.
Generator's name _____
Manifest Document Number _____".

3.3.3 Shipping Documents

The Contractor shall ensure that each shipment of hazardous material sent off-site is accompanied by properly completed shipping documents. This includes shipments of samples that may potentially meet the definition of a Department of Transportation regulated hazardous material.

3.3.3.1 PCB Waste Shipment Documents

The Contractor shall prepare hazardous waste manifests for each shipment of PCB waste shipped off-site. Manifests shall be completed using instructions in 40 CFR 761, Sections .207 and .208 and all other applicable requirements. Documents shall be submitted to Contracting Officer for review and approval.

3.3.3.2 Asbestos Waste Shipment Documents

The Contractor shall prepare waste shipment records as required by 40 CFR 61 for shipments of asbestos. Waste shipment records shall be submitted to the Contracting Officer for review and approval. Waste shipment records shall be signed by the Contractor.

3.3.3.3 Other Hazardous Material Shipment Documents

The Contractor shall prepare a bill of lading for each shipment of hazardous material which is not accompanied by a hazardous waste manifest or asbestos waste shipment record which fulfills the shipping paper requirements. The bill of lading shall satisfy the requirements of 49 CFR 172, Subpart C, and 40 CFR 279 if shipping used oil and any applicable state or local law or regulation, and shall be submitted to the Contracting Officer for review and approval. For laboratory samples and treatability study samples, the Contractor shall prepare bills of lading and other documentation as necessary to satisfy conditions of the sample

exclusions in 40 CFR 261, Section .4(d) and (e) and any applicable state or local law or regulation. Bill of ladings requiring shipper's certifications will, shall be signed by the Government, Contractor.

3.4 OBTAINING EPA ID NUMBERS

The Contractor shall complete EPA Form 8700-12, Notification of Hazardous Waste Activity, and submit to the Contracting Officer for review and approval. The Contractor shall allow a minimum of 30 days for processing the application and assigning the EPA ID number. Shipment shall be made not earlier than one week after receipt of the EPA ID number.

3.5 SPECIAL REQUIREMENTS FOR ASBESTOS WASTES

If work involves asbestos containing wastes, the Contractor shall manage these wastes in accordance with specification Section _____.

3.6 WASTE MINIMIZATION

The Contractor shall minimize the generation of hazardous waste to the maximum extent practicable. The Contractor shall take all necessary precautions to avoid mixing clean and contaminated wastes. The Contractor shall identify and evaluate recycling and reclamation options as alternatives to land disposal. Requirements of 40 CFR 266 shall apply to: hazardous wastes recycled in a manner constituting disposal; hazardous waste burned for energy recovery; lead-acid battery recycling; and hazardous wastes with economically recoverable precious metals.

3.7 RECORDKEEPING

The Contractor shall be responsible for maintaining adequate records to support information provided to the Contracting Officer regarding exception reports, annual reports, and biennial reports. The Contractor shall be responsible for maintaining asbestos waste shipment records for a minimum of 3 years from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract. The Contractor shall be responsible for maintaining bill of ladings for a minimum of 375 days from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract.

3.8 SPILL RESPONSE

The Contractor shall respond to any spills of hazardous material or hazardous waste which are in the custody or care of the Contractor, pursuant to this contract. Any direction from the Contracting Officer concerning a spill or release shall not be considered a change under the contract. The Contractor shall comply with all applicable requirements of Federal, state, or local laws or regulations regarding any spill incident.

3.9 EMERGENCY CONTACTS

The Contractor shall be responsible for complying with the emergency contact provisions in 49 CFR 172, Section .604. Whenever the Contractor ships hazardous materials, the Contractor shall provide a 24 hr emergency response contact and phone number of a person knowledgeable about the hazardous materials being shipped and who has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information. The phone must be monitored on a 24 hour basis at all times when the

hazardous materials are in transportation, including during storage incidental to transportation. The Contractor shall ensure that information regarding this emergency contact and phone number are placed on all hazardous material shipping documents. The Contractor shall designate an emergency coordinator and post the following information at areas in which hazardous wastes are managed:

a. The name of the emergency coordinator.

b. Phone number through which the emergency coordinator can be contacted on a 24 hour basis.

c. The telephone number of the local fire department.

d. The location of fire extinguishers and spill control materials.

Attachment A
SAMPLE OFF-SITE POLICY CERTIFICATION MEMO

Project/Contract #:_____
Waste Stream:_____
Primary TSD Facility, EPA ID # and Location: _____
Alter. TSD Facility, EPA ID # and Location:_____

EPA Region	Contact
I	(617) 918-1752
II	(212) 637-4130
III	(214) 814-5267
IV	(404) 562-8591
V	(312) 353-8207
VI	(214) 665-2282
VII	(913) 551-7154
VIII	(303) 312-6419
IX	(415) 972-3304
X	(206) 553-2859

EPA representative contacted: _____
EPA representative phone number: _____
Date contacted: _____

Comment: _____
The above EPA representative was contacted on _____. As of that date the above sites were considered acceptable in accordance with the Off-Site Policy in 40 CFR 300.440.

Signature: _____ Date: _____
Phone number: _____

-- End of Section --

SECTION 02 82 16

REMOVAL AND DISPOSAL OF ASBESTOS MATERIALS
(CAMP LEJEUNE COMPLEX)

03/10

PART 1 GENERAL

1.1 APPLICABLE NORTH CAROLINA LAW

North Carolina State General Statues 130A, Article 19-444-452 and 10A North Carolina Administrative Chapter (NCAC) 41C .0600 through .0611.

1.1.1 N.C. (DHHS-HHCU) Asbestos Accreditation

All personnel involved in asbestos removal shall be currently accredited for asbestos removal by N.C. (DHHS-HHCU). An application for accreditation may be requested from the State of North Carolina, Health Hazards Control Unit, Department of Health and Human Services, Division of Public Health,; 1912 Mail Service Center, Raleigh, NC 27699-1912; (919) 707-5950. Out of State accreditation will not be accepted.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2	(1992) Respiratory Protection

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 732	(1995) Aging Effects of Artificial Weathering on Latex Sealants
ASTM D 1331	(1989; R 1995) Surface and Interfacial Tension of Solutions of Surface-Active Agents
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1997; Rev A) Water Vapor Transmission of Materials
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

ASTM E 1368	(1997) Visual Inspection of Asbestos Abatement Projects

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.103	Respiratory Protection
29 CFR 1926.59	Hazard Communication
29 CFR 1926.1101	Asbestos
40 CFR 61, SUBPART A	General Provisions
40 CFR 61, SUBPART M	National Emission Standard for Hazardous Air Pollutants

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 560/5-85-024	(1985) Guidance for Controlling Asbestos Containing Materials in Buildings
EPA SW-846	(Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II)

UNDERWRITERS LABORATORIES (UL)

UL 586	(1996; Rev thru Aug 1999) High-Efficiency, Particulate, Air Filter Units

1.3 DEFINITIONS

1.3.1 Asbestos Containing Material (ACM)

All building materials that have more than 1% of chrysotile, amosite, crocidolite, tremolite, anthopyhlite, or any other form of asbestos in the serpentine or anthobole class.

1.3.2 Action Level/Permissive Exposure Limit (PEL)

An airborne concentration of asbestos fibers, in the breathing zone of a worker equaling 0.1 fibers per cubic centimeter of air calculated as an 8-hour time weighted average.

1.3.3 Amended Water

Water containing a wetting agent or surfactant with a surface tension of 29 dynes per square centimeter when tested in accordance with ASTM D 1331 shall be utilized. In the event where wetting operations are suspended due to freezing temperatues, the operator or abatement contractor shall record the temperature on Form DHHS 3787..

1.3.4 Area Sampling

Sampling of asbestos fiber concentrations within the asbestos control area and outside the asbestos control area which approximates the concentrations

of asbestos in the theoretical breathing zone but is not actually collected in the breathing zone of an employee.

1.3.5 Asbestos

The term asbestos includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite and any of these minerals that has been chemically treated or altered. Materials are considered to contain asbestos if the asbestos content is more than 1% of the material by area.

1.3.6 Asbestos Control Area

That area where asbestos removal operations are performed which is isolated by physical boundaries which assist in the prevention of the uncontrolled release of asbestos dust, fibers, or debris. Two examples of an asbestos control area are: a full containment and a "glovebag."

1.3.7 Asbestos Fibers

Those fibers having an aspect ratio of at least 3:1 and longer than 5 micrometers as determined by National Institute for Occupational Safety and Health (NIOSH) Method 7400.

1.3.8 Asbestos Permissible Exposure Limit

0.1 fibers per cubic centimeter of air as an 8-hour time weighted average as defined by 29 CFR 1926.1101 or other federal legislation having legal jurisdiction for the protection of workers health.

1.3.9 Background

Normal airborne asbestos concentration in an area similar to the asbestos abatement area but in an uncontaminated (with asbestos) state.

1.3.10 Contractor

The Contractor is that individual, or entity under contract to the Navy to perform the herein listed work.

1.3.11 Encapsulants

Specific materials in various forms used to chemically entrap asbestos fibers in various configurations to prevent these fibers from becoming airborne. There are four types of encapsulants as follows which must comply with performance requirements as specified herein.

a. Removal Encapsulant (can be used as a wetting agent)

b. Bridging Encapsulant (used to provide a tough, durable surface coating to asbestos containing material)

c. Penetrating Encapsulant (used to penetrate the asbestos containing material down to substrate, encapsulating all asbestos fibers)

d. Lock-Down Encapsulant (used to seal off or "lock-down" minute asbestos fibers left on surfaces from which asbestos containing material has been removed)

1.3.12 Friable Asbestos Material

Material that contains more than 1% asbestos by area and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.3.13 Full Containment

Those engineering control techniques described in 29 CFR 1926.1101 for major asbestos removal, renovation and demolition operations.

1.3.14 Glovebag Technique

Those asbestos removal and control techniques put forth in 29 CFR 1926.1101.

1.3.15 HEPA Filter Equipment

High efficiency particulate air (HEPA) filtered vacuum and/or exhaust ventilation equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall retain 99.97 percent of particles 0.3 microns or larger as indicated in UL 586.

1.3.16 Navy Industrial Hygienist (NIH)

That industrial hygienist employed by the Navy to monitor, sample, and/or inspect the work separate from the original construction contract. The NIH can be either a Federal civil servant or a private consultant as determined by the Navy. In some instances the NIH shall perform assigned duties vicariously through a trained subordinate but only with the specific consent of the Contracting Officer.

1.3.17 Nonfriable Asbestos Material

Material that contains asbestos in which the fibers have been temporarily locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not normally release asbestos fibers during any appropriate use, handling, storage or transportation. It is understood that asbestos fibers will be released under other conditions such as demolition or removal.

1.3.18 PCM - Phased Contrast Microscopy

A method of analyzing air samples for fibers using a light microscope.

1.3.19 PLM - Polarized Light Microscopy

A method of analyzing bulk samples for asbestos in which the sample is illuminated with polarized light (light which vibrates in only one plane) and viewed under a light microscope.

1.3.18 Personal Sampling

Air sampling to determine asbestos fiber concentrations within the breathing zone of a specific employee, performed in accordance with 29 CFR 1926.1101.

1.3.19 Supervising Air Monitor (SAM)

That supervising air monitor hired by the Contractor to perform the herein listed industrial hygiene tasks. In some instances, the SAM can perform this role vicariously through a trained subordinate, but only with the specific consent of the Contracting Officer. Under N.C. Statue, the SAM must make a site visit on any project exceeding 10 days and once every 30 days thereafter.

1.3.20 TEM

Refers to Transmission Electron Microscopy (TEM). Technique whereby a beam of electrons is transmitted through an ultra think specimen, interacting with the specimen as it passes through. An image is formed from the interaction of the electrons transmitted through the specimen; the image is magnified and focused onto an imaging device, such as a fluorescent screen, on a layer of photographic film, or to be detected by a sensor such as a CCB camera.

1.3.21 Time Weighted Average (TWA)

The TWA is an 8-hour time weighted average airborne concentration of asbestos fibers. At least three full shift samples per person are required to establish that person's TWA exposure.

1.3.22 Wetting Agent

That specific agent used to reduce airborne asbestos levels by physically bonding asbestos fibers to material to be removed. An equivalent wetting agent must have a surface tension of at least 29 dynes per square centimeter as tested in accordance with ASTM D 1331. In the event where wetting operations are suspended due to freezing temperatures, the operator or abatement contractor shall record the temperature on Form DHHS 3787.

1.4 REQUIREMENTS

1.4.1 Description of Work

The work covered by this section includes the handling of asbestos containing materials which are encountered during repair, construction and demolition projects and describes some of the resultant procedures and equipment required to protect workers and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of the generated asbestos containing materials. The asbestos work includes the demolition and removal of [_____] located [_____]. [Under normal conditions non-friable or chemically bound materials containing asbestos would not be considered hazardous; however, this material will release airborne asbestos fibers during demolition and removal and therefore must be handled in accordance with North Carolina Regulations.

1.4.2 N. C. (DHHS-HHCU) North Carolina Department of Health and Human Services - Health Hazards Control Unit

Obtain necessary permits in conjunction with asbestos removal, hauling, and disposition, and furnish timely notification of such actions required by federal, state, regional, and local authorities. A permit is only required when you will be abating more than 260 linear feet, 160 square feet, or 35 cubic feet of an asbestos-containing building material. Also, if mechanical means of removing non-friable asbestos is utilized the contractor will need

to provide permit. Notify the N.C. (DHHS-HHCU) and the Contracting Officer in writing 10 days prior to the commencement of work. Submit a copy of the permit to the Contracting Officer.

1.4.2.1 N.C. (DHHS-HHCU) mailing address is:

Health Hazards Control Unit
N.C. Department of Health and Human Services
Division of Public Health
1912 Mail Service Center
Raleigh, NC 27699-1912
Phone: (919) 733-0820

1.4.2.2 Changes in Work

Changes in Work which affect items on the attached form shall be covered by an amended form submitted to the same address.

1.4.3 Safety and Health Compliance

In addition to detailed requirements of this specification, comply with those applicable laws, ordinances, criteria, rules, and regulations of federal, state, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.1101, 40 CFR 61, SUBPART A, 40 CFR 61, SUBPART M. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification, applicable laws, rules, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirement as defined by the Contracting Officer shall apply.

1.4.4 Respiratory Protection Program

Establish and implement a respirator program as required by ANSI Z88.2 and 29 CFR 1910.103.

1.4.5 Supervising Air Monitor (SAM)

Conduct personal area/environmental air sampling and training under the direction of a North Carolina accredited supervising air monitor. For the purpose of this contract, the Contractor shall retain the services of a SAM to perform the Contractor's industrial hygiene tasks.

1.5 SUBMITTALS

Submit 4 copies of the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-06 Test Reports

Air sampling results

Pressure differential recordings for local exhaust system

Clearance sampling

[SD-07 Certificates

Asbestos hazard abatement plan (Abatement Design)]

SD-11 Closeout Submittals

Asbestos Waste Shipment Record N.C. (DHHS-HHCU) Form 3787

Daily log

North Carolina permit

Modifications to the North Carolina permit

Asbestos Inspection Reporting Form

1.5.1 Asbestos Hazard Abatement Plan (NC Abatement Design)

An asbestos abatement design shall be prepared by a N.C. accredited asbestos abatement designer for each individually permitted removal of more than 260 linear feet, 160 square feet, or 35 cubic feet of regulated asbestos containing materials. The plan shall be prepared, signed, and sealed, including accreditation number and date, by an accredited abatement designer. The respirator program and air monitoring strategies portion of this plan shall be prepared by the supervising air monitor. Such plan shall include but not be limited to the precise personal protective equipment to be used, the location of asbestos control areas including clean and dirty areas, buffer zones, showers, storage areas, change rooms, removal method, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos sealer to be used, locations of local exhaust equipment, planned air monitoring strategies, and a detailed description of the method to be employed in order to control pollution. The plan shall also include (both fire and medical emergency) response plans. The Contractor and designer shall meet with the Contracting Officer prior to beginning work, to discuss in detail the asbestos plan, including work procedures and safety precautions. The plan will be enforced as if an addition to the specification. Any changes required in the specification as a result of the plan shall be identified specifically in the plan. The plan shall comply with all federal and state requirements and this specification, and shall serve as the North Carolina Abatement Design. Submit a copy of plan to the Contracting Officer.

1.5.2 Air Sampling Results

Complete fiber counting and provide results to the SAM for review within 16 hours. Notify the Contracting Officer immediately of any airborne levels of asbestos fibers in excess of the acceptable limits. Submit sampling results to the Contracting Officer and the affected Contractor employees within 3 working days, signed by the employee performing air sampling, the employee that analyzed the sample, and the SAM.

1.5.3 Pressure Differential Recordings for Local Exhaust System

Provide a local exhaust system that creates a negative pressure of at least 0.02 inches of water relative to the pressure external of the enclosure and operate it continuously, 24 hours a day, until the enclosure of the asbestos control area is removed. Provide continuous 24-hour per day monitoring of

the pressure differential with a pressure differential automatic recording instrument. Submit pressure differential recordings for each work day to the SAM for review and to the Contracting Officer within 24 hours from the end of each work day. Notify the Contractor and the Contracting Officer immediately of any variance in the pressure differential which could cause adjacent unsealed areas to have asbestos fiber concentrations in excess of 0.01 fibers per cubic centimeter or background whichever is higher. In no circumstance shall levels exceed 0.1 fibers per cubic centimeter.

1.5.4 Asbestos Waste Shipment Record N.C. (DHHS-HHCU) Form 3787

Record and report, to the Contracting Officer, the amount of asbestos containing material removed and released for disposal. Deliver the report for the previous day at the beginning of each day shift with amounts of material removed during the previous day reported in linear feet or square feet as described initially in this specification and in cubic feet for the amount of asbestos containing material released for disposal. Use "Asbestos Waste Shipment Record N.C. (DHHS-HHCU) Form 3787 for this report. A copy of the (DHHS-HHCU) Form 3787 must accompany any asbestos waste shipment to the Base sanitary landfill.

1.5.5 Daily Log

A daily log documenting work practices, sample locations, and all other asbestos related job conditions shall be maintained, by the testing lab and be available for Government examination throughout the course of work. At the completion of testing, a copy of this log shall be immediately delivered to the Government.

1.5.6 North Carolina Permit

Submit one copy of the North Carolina Permit before beginning abatement activities to the Contracting Officer.

1.5.7 Modifications to the North Carolina Permit

Submit a copy of all permit modifications to the Contracting Officer. These must be received before they become effective. The Contractor is responsible for proper permit modification notification to the State. Modifications may be delivered to the Contracts Office or transmitted by facsimile to (910) 411-5899.

1.5.8 Asbestos Inspection Reporting Form

This Asbestos Inspection Reporting Form is included at the end of this section and shows the homogeneous areas involved with this project. The Contractor shall mark the line "confirmed ACM from this HA:" as either "Abated" or "Managed in Place." Abated shall be defined as removed. If an HA is partially abated, approximate the percentage of asbestos removed and mark in the comments area. Provide any other descriptive data, such as rooms/areas removed or rooms/areas where asbestos not removed. The intent of this requirement is to report "as built" conditions. The Contractor is not required to perform any additional asbestos surveys or inspections as a result of this paragraph. Include this report with drawing of abated areas with other closeout documentation.

1.6 PRE-ABATEMENT MEETING

The Contractor and designer shall meet with the Contracting Officer prior to beginning work, to discuss in detail the asbestos plan, including work procedures and safety precautions.

1.7 ASBESTOS INSPECTION REPORTING FORM AND ASBESTOS SAMPLE REPORTING FORM

These two forms are included at the end of this section for informational purposes. They do not define or modify the scope of work.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Shall conform to current USEPA requirements, shall contain no toxic or hazardous substances as defined in 29 CFR 1926.59, and shall conform to the following performance requirements. Use of encapsulants is generally restricted to the surface of the temporary enclosure and to areas that are not to be refinished such as attics and crawlspaces. The proposed use of encapsulants shall be included in the abatement design.

2.1.1 Removal Encapsulants

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Life Expectancy - 20 years	ASTM C 732, Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E 96

2.1.2 Lock-down Encapsulant

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Life Expectancy - 20 years	ASTM C 732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E 96
Fire Resistance - Negligible affect on fire resistance rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	ASTM E 119
Bond Strength - 100 pounds of force/ foot (Tests compatibility with cementitious and fibrous fire-proofing)	ASTM E 736

2.1.3 Plastic Sheet

Plastic sheet, polyethylene, 6 mil minimum thickness, unless otherwise specified, in sizes to minimize the frequency of joints. All asbestos material or debris will be at least double bagged or wrapped in two layers of 6 mil poly sheeting.

2.1.4 Tape

Capable of sealing joints of adjacent sheets or plastic sheets and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under dry and wet conditions, including use of amended water.

2.1.5 Disposal Bags

Bags shall be a minimum of 6 mil thick polyethylene. Affix a warning and Department of Transportation (DOT) label to each bag or use bags with the approved warnings and DOT labeling preprinted on the bag.

2.1.6 Warning Labels

Provide labels conforming to 29 CFR 1926.1101 of sufficient size to be clearly legible, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING ASBESTOS DUST MAY
CAUSE SERIOUS BODILY HARM

PART 3 EXECUTION

3.1 DISPOSAL SITE

CAMP LEJEUNE SANITARY LANDFILL
982 PINEY GREEN ROAD
CAMP LEJEUNE, NC 28542
(910) 451-5011

Base Sanitary Landfill shall be used for disposal of all asbestos waste. The Base Sanitary Landfill is approved and is available for use by the Contractor providing the following requirements are satisfied:

a. The Contracting Officer must be informed at least five working days in advance of the anticipated delivery date of the asbestos material to the Landfill. On larger projects, the notification should be accompanied by a cubic yard estimate of the anticipated volume, updated weekly if the disposal period extends for more than one week. The Government will be responsible for digging the trenches and covering the debris at the end of the working day. Debris will not be accepted before 8:00 AM or after 10:00 AM, except in an emergency situation.

b. Asbestos will be accepted only if adequately wet and double bagged in heavy-duty 6 mil plastic bags which are clearly marked

"Asbestos." If a Contractor desires to handle the asbestos in a manner other than double-bagged, written application, along with a description of the proposed deviation, must be submitted to the OICC and Landfill Manager for approval.

c. Asbestos insulated piping with the asbestos insulation intact will be accepted if the following requirements are met:

1. The pipe is cut in eight foot or shorter lengths

2. Each section of pipe is double wrapped, sealed, and labeled as asbestos.

3. All pipe is palletized on a 7/8-inch, 4- by 8-foot sheet of plywood. The whole pallet is banded with a minimum of three 1-inch wide metal bands with the coupling on top and wrapped with 6-mil plastic. The pallet is not higher than 3-inches.

d. All asbestos, except palletized pipe will be off loaded and placed in the trench pipe hand.

e. Asbestos disposal is restricted to one designated location in the Landfill and the landfill operators must be informed of and direct each delivery. Asbestos shall be disposed of from 0800 to 1000 hours daily, except holidays and weekends. Trucks hauling asbestos must be properly covered with tarpaulins or equivalent. Trucks not covered properly must be parked until the Contracting Officer approves corrective actions.

f. The Contractor will ensure asbestos contaminated material delivered to the Base Sanitary Landfill contain no free liquids. Free liquids are defined as material which fails the EPA SW-846 free liquids test.

g. The Contractor will include all asbestos waste shipment records (DHHS-HHCU Form 3787) that are filled out completely with the correct information, to the project manager after abatement job is completed.

3.2 EQUIPMENT

Make available to the Contracting Officer or the Contracting Officer's Representative, [two] [___] complete sets of personal protective equipment as required herein for entry to the asbestos control area at all times for inspection of the asbestos control area. Provide equivalent training to the Contracting Officer or a designated representative as provided to Contractor employees in the use of the required personal protective equipment. Provide manufacturer's certificate of compliance for all equipment required to contain airborne asbestos fibers.

3.2.1 Respirators

Comply with 29 CFR 1926.1101.

3.3 WORK PROCEDURE

Remove all friable and non-friable ACM in accordance with all Federal, State, and local Marine Corps regulations. Ensure that the asbestos abatement plan is followed throughout all aspects of the abatement process.

3.3.1 Furnishings

[Furniture [,(_____)] and equipment will be removed from the area of work by the Government before asbestos work begins.]

[Furniture [,(_____)] and equipment will remain in the building. Cover and seal furnishings with 6-mil plastic sheet or remove from the work area and store in a location on site approved by the Contracting Officer.]

Furnishings listed below and located in the work area are considered to be contaminated with asbestos fibers. Transfer these items to an area on site approved by the Contracting Officer, decontaminate (wet methods where possible), and then store until the room from which they came is declared clean and safe for entry. [Carpets, draperies, and other items which may not be suitable for on-site wet cleaning methods shall be properly laundered as recommended by the SAM so as to remove all asbestos contamination or disposed of at the Contracting Officer's discretion.] At the conclusion of the asbestos removal work and cleanup operations, transfer all objects so removed and cleaned back to the area from which they came and re-install them. Base bids on decontaminating:

a. [_____] Desks

b. [_____] Filing cabinets

c. [_____] Linear feet of shelving

d. [_____] Cubic Feet of books, papers, files, etc.

e. [_____]

3.3.2 Pipe Insulation

Pipe may be removed with the asbestos insulation in place by wrapping the entire length of pipe and associated insulation with double thickness 6 mil plastic secured with duct tape. Mechanically cutting of asbestos containing insulation is prohibited. When using the "candy-stripe" method the abatement contractor must use glovebag operations to establish an "asbestos free" area to cut the pipe into appropriate lengths. Cut piping simultaneously into lengths suitable for transportation to disposal area, but no greater than 8 feet in length. Continuously wet the cutting site during the process. As soon as a length of pipe is completely cut loose, cover exposed ends with double thickness 6 mil plastic secured with duct tape. If the pipe is to remain in service, the removed pipe must be replaced in accordance with this Specification, with a pipe of the same size that is removed.

3.3.2.1 Attic Insulation

In those buildings indicated on the drawings, attic insulation consisting of any combination of blown-in or batt fiberglass or rockwool material, has been contaminated with asbestos materials, and is to be removed as contaminated asbestos material. The insulation material shall be wet with a

fine mist of amended water. The material shall be placed immediately in double thickness 6 mil plastic bags for disposal as asbestos waste.

3.3.2.2 Contaminated Soil

In those buildings so indicated on the drawings, asbestos materials are located in the building crawl spaces and deterioration of the asbestos material has resulted in contamination of the soil under the building. Under the indicated area of these buildings, asbestos material and [2] [ ] inches of soil shall be removed and one sheet of plastic, 6 mils thick, spread over the area with seams lapped a minimum of 4 inches. [Sand shall be placed a minimum of [2] [ ] inches thick over the plastic]. Removal shall occur just prior to clean-up operations. All debris in the crawl space shall be disposed of with the soil as asbestos materials. Workers shall be equipped with respirators and protective clothing during the removal of soil and debris.

3.3.2.3 Non-Organic Bound (NOB) Asbestos Materials

These kind of materials include floor tile, mastic, caulking, roofing material, and other non-friable material. Materials are to be adequately wet before removal and double bagged with a 6 mil poly bag. Ensure that bags have been labeled properly before they are taken to the Base Landfill.

3.3.3 Air Sampling

Sampling of airborne concentrations of asbestos fibers shall be performed in accordance with 29 CFR 1926.1101 and as specified herein. Sampling performed in accordance with 29 CFR 1926.1101 shall be performed by the SAM. Sampling performed for environmental and quality control reasons shall be performed by the SAM. Unless otherwise specified, use NIOSH Method 7400 for sampling and analysis. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those results obtained by the Contractor, the Government results shall prevail.

3.3.3.2 Sampling During Asbestos Work

The SAM shall provide personal and area sampling as indicated in 29 CFR 1926.1101 and governing environmental regulations. Thereafter, provided the same type of work is being performed, provide area sampling at least once every work shift close to the work inside the containment, outside the clean room entrance to the containment, and at the exhaust opening of the local exhaust system. Also, where an enclosure is not provided, conduct area monitoring of airborne asbestos fibers during the work shift at the designated limits of the asbestos work area at such frequency as recommended by the SAM and conduct personal samples of each worker engaged in asbestos handling (removal, disposal, transport and other associated work). If the quantity of airborne asbestos fibers monitored at the breathing zone of the workers or designated limits at any time exceeds background or 0.01 fibers per cubic centimeter whichever is lesser outside of the containment area, stop work, evacuate personnel in adjacent areas or provide personnel with approved protective equipment at the discretion of the Contracting Officer. This sampling may be duplicated by the government at the discretion of the Contracting Officer. If the air sampling results obtained by the government differ from those obtained by the Contractor, the government results shall prevail. If adjacent areas are contaminated as determined by the

Contracting Officer, clean the contaminated areas, monitor, and visually inspect the area as specified herein.If sampling outside the containment shows airborne levels have exceeded background or 0.01 fibers per cubic centimeter, whichever is greater, stop all work, correct the condition(s) causing the increase, and notify the Contracting Officer immediately. [In areas where the construction of a containment is not required, after initial TWAs are established and provided the same type of work is being performed, provide sampling at the designated limits of the asbestos work area at such frequency as recommended by the SAM.] [Where glovebag methods are used, perform personal and area air sampling at locations and frequencies thatwill accurately characterize the evolving airborne asbestos levels.]]

3.3.3.3 Sampling After Final Clean-Up (Clearance Sampling) For All Areas Unless Noted Otherwise

Provide area sampling of asbestos fibers using aggressive air sampling techniques as defined in the EPA 560/5-85-024 and establish an air borne asbestos concentration of less than 70 structures per square millimeter after final clean-up but before removal of the containment or the asbestos work control area. After final cleanup and the asbestos control area is dry but prior to clearance sampling, the SAM shall perform a visual inspection, in accordance with ASTM E 1368, to insure that the asbestos control and work area is free of any accumulations of dirt, dust, or debris. Use transmission electron microscopy (TEM) to analyze clearance samples and report the results in accordance with current NIOSH criteria. The asbestos fiber counts from these samples shall be less than 70 structures per square millimeter or be not greater than the background, whichever is greater. Should any of the final samples indicate a higher value, the Contractor shall take appropriate actions to re-clean the area and shall repeat the sampling and TEM analysis at the Contractor's expense.

3.3.3.3 [Sampling After Final Clean-Up (Clearance Sampling) For the Following Areas [_____]

Provide area sampling of asbestos fibers [using aggressive air sampling techniques as defined in the EPA 560/5-85-024] and establish an air borne asbestos concentration of less than 0.01 fibers per cubic centimeter after final clean-up but before removal of the containment or the asbestos work control area. After final cleanup and the asbestos control area is dry but prior to clearance sampling, the SAM shall perform a visual inspection, in accordance with ASTM E 1368, to insure that the asbestos control and work area is free of any accumulations of dirt, dust, or debris. Should any of the final samples indicate a higher value, the Contractor shall take appropriate actions to re-clean the area and shall repeat the sampling and analysis at the Contractor's expense.]

3.3.4 Lock Down

Prior to removal of plastic barriers and after pre-clearance clean up of gross contamination, a visual inspection by the SAM, of all areas affected by the removal of the asbestos contaminated materials for any visible fibers, shall be conducted and approved by the SAM. A post removal (lock down) encapsulant shall then be spray applied to ceiling, walls, floors and other areas exposed in the removal area. The exposed area shall include but not be limited to plastic barriers, furnishings and articles to be discarded as well as dirty change room, air locks for bag removal and decon chambers.

3.3.5 Site Inspection

While performing asbestos removal work, the Contractor shall be subject to on-site inspection by the Contracting Officer who may be assisted by or represented by safety or industrial hygiene personnel. If the work is found to be in violation of this specification, the Contracting Officer or his representative will issue a stop work order to be in effect immediately and until the violation is resolved. Standby time required to resolve the violation shall be at the Contractor's expense.

3.4 CLEAN-UP AND DISPOSAL

3.4.1 Housekeeping

Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Use HEPA filtered vacuum cleaners. Do not blow down the space with compressed air. When asbestos removal is complete, all asbestos waste is removed from the work-site, final clean-up is completed, and final air sampling results are reported, the SAM will certify the area as safe and the Conrracting Officer will approve the abatement completion, before the signs can be removed. After final clean-up and acceptable airborne concentrations are attained but before the HEPA unit is turned off and the containment removed, remove all pre-filters on the building HVAC system and provide new pre-filters. Dispose of filters as asbestos-contaminated materials. Reestablish HVAC mechanical, and electrical systems in proper work ing order. The Contracting Officer will visually inspect all surfaces within the containment for residual material or accumulated dust or debris. The Contractor shall re-clean all areas showing dust or residual materials. If re-cleaning is required, air sample and establish an acceptable asbestos airborne concentration after re-cleaning. The SAM will provide written certification that the work area is safe within all standards as referenced within this contract before unrestricted entry is permitted. The Government shall have the option to perform monitoring to certify the areas are safe before entry is permitted.

3.4.2 Title to Materials

All materials resulting from demolition work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified in applicable local, state, and Federal regulations and herein. All building materials that are cross contaminated must be disposed of as an ACM at Base Landfill.

3.4.3 Disposal of Asbestos

3.4.3.1 Procedure for Disposal

Collect asbestos waste, asbestos contaminated water, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing which may produce airborne concentrations of asbestos fibers and place in sealed fiberproof, waterproof, non-returnable containers (e.g. double plastic bags 6 mils thick, cartons, drums or cans). Wastes within the containers must be wetted to insure the security of the material in case of container breeching. Affix a warning and Department of Transportation (DOT) label to each bag or

use at least 6 mil thick bags with the approved warnings and DOT labeling preprinted on the bag. For temporary storage, store sealed impermeable bags in asbestos waste drums or skids. An area for interim storage of asbestos waste-containing drums or skids will be assigned by the Contracting Officer or his authorized representative. Procedure for haul ing and disposal shall comply with 40 CFR 61, SUBPART M, state, regional, and local standards.

3.4.3.2 Disposal Material Shall Contain No Free Liquid

The Contractor will ensure asbestos contaminated material delivered to the Base Sanitary Landfill contain no free liquids. Free liquids are defined as material which fails the EPA SW-846 Free Liquids Test.

-- End of Section --

Asbestos Inspection Reporting Form

Required under contractual agreement with Marine Corps Base, Camp Lejeune

Instructions: Supply the following information by filling in the blanks or selecting (checking) appropriate boxes.

General Information

Building Number	_____	**Date of Activity**	_____
Contractor Name	_____	**Contract Number**	_____
Inspector Name	_____	**Inspector Accreditation Number**	_____
Public Works POC	_____		

Inspection Information

Homogeneous Area (HA) ID Number: _____

(for additional HAs, please use Continuation Sheets)

Homogeneous Description:	**Homogeneous Location:**

ACM Type: ☐ Surfacing Material ☐ Thermal System Insulation ☐ Miscellaneous

Friability: ☐ High ☐ Moderate ☐ Low ☐ Non

Estimated Quantity of ACM: _____ ☐ Sq Feet ☐ Linear Feet ☐ Other _____

Damage Designation: ☐ Localized ☐ Distributed

Potential for Contact: ☐ Low ☐ Moderate ☐ High
(by building occupants)

Influence of Vibration: ☐ Low ☐ Moderate ☐ High

Influence of Air Erosion: ☐ Low ☐ Moderate ☐ High

Overall Potential for Disturbance: ☐ Low ☐ Moderate ☐ High

Percent Damage _____ %

Number of Samples Collected: _____
(NOTE: Sample Results Entered on the Asbestos Sample Reporting Forms)

Laboratory Sampling Analysis Method: ☐ Polarized Light Microscopy (AHERA Recommendation)
☐ Other _____

Confirmed ACM from this HA: ☐ Abated **or** ☐ Managed in Place

Inspection Activity Resulting From: ☐ Total Renovation ☐ Demolition
☐ Partial Renovation (Please Describe)

Comments:

Asbestos Sample Reporting Form

Instructions: Supply the following information by filling in the blanks or checking the appropriate box. An example entry is provided to illustrate a correct response.

Bldg No.	HA No.	Sample No.	Date	Description of Material Sampled	Location of Material Sampled	CHR[1] %	AMO[1] %	CRO[1] %	Other[2] %	Positive[3]	Comments
Example	1	1	5/1/1996	Ceiling Tile 1'x1', white	ISMD Storage	ND	ND	ND		☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	

[1]Percent of chrysotile (chr), amocite (amo), and crocidolite (cro). If no amount was detected, then "ND" should be entered under the appropriate column.

[2]Comments describing other suspect mineral types.

[3]Indication of positive for asbestos (this box is checked where no quantitative results exist, but records indicate that the sample is positive for asbestos).

Homogeneous Area (HA) Continuation Form

Provide the following information for each additional HA

HA ID Number: _____ **Bldg Number:** _____

HA Description:

HA Location:

ACM Type: ☐ Surfacing Material ☐ Thermal System Insulation ☐ Miscellaneous

Friability: ☐ High ☐ Moderate ☐ Low ☐ Non

Est Qty of ACM: _____ ☐ Sq Ft ☐ LF ☐ Other _____

Damage Designation: ☐ Localized ☐ Distributed

Potential for Contact: ☐ Low ☐ Moderate ☐ High

Influence of Vibration: ☐ Low ☐ Moderate ☐ High

Influence of Air Erosion: ☐ Low ☐ Moderate ☐ High

Overall Potential for Disturbance: ☐ Low ☐ Moderate ☐ High

Percent Damage _____ %

No. of Samples Collected: _____

Laboratory Sampling analysis Method: ☐ PLM ☐ Other _____

Confirmed ACM from this HA: ☐ Abated **or** ☐ Managed in Place

Inspection Activity Resulting From: ☐ Demolition ☐ Total Renovation ☐ Partial Renovation (please describe)

Comments:

HA ID Number: _____ **Bldg Number:** _____

HA Description:

HA Location:

ACM Type: ☐ Surfacing Material ☐ Thermal System Insulation ☐ Miscellaneous

Friability: ☐ High ☐ Moderate ☐ Low ☐ Non

Est Qty of ACM: _____ ☐ Sq Ft ☐ LF ☐ Other _____

Damage Designation: ☐ Localized ☐ Distributed

Potential for Contact: ☐ Low ☐ Moderate ☐ High

Influence of Vibration: ☐ Low ☐ Moderate ☐ High

Influence of Air Erosion: ☐ Low ☐ Moderate ☐ High

Overall Potential for Disturbance: ☐ Low ☐ Moderate ☐ High

Percent Damage _____ %

No. of Samples Collected: _____

Laboratory Sampling analysis Method: ☐ PLM ☐ Other _____

Confirmed ACM from this HA: ☐ Abated **or** ☐ Managed in Place

Inspection Activity Resulting From: ☐ Demolition ☐ Total Renovation ☐ Partial Renovation (please describe)

Comments:

Asbestos Sample Reporting Continuation Form

Provide the following information for each additional asbestos sample.

Bldg No.	HA No.	Sample No.	Date	Description of Material Sampled	Location of Material Sampled	CHR[1] %	AMO[1] %	CRO[1] %	Other[2] %	Positive[3]	Comments
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	

[1]Percent of chrysotile (chr), amocite (amo), and crocidolite (cro). If no amount was detected, then "ND" should be entered under the appropriate column.

[2]Comments describing other suspect mineral types.

[3]Indication of positive for asbestos (this box is checked where no quantitative results exist, but records indicate that the sample is positive for asbestos).

SECTION 02 82 17

REMOVAL AND DISPOSAL OF NON-REGULATED ASBESTOS CONTAINING MATERIAL (NON-RACM)

01/07

PART 1 GENERAL

1.1 REQUIREMENTS

The work covered by this section includes the handling of non-friable asbestos containing materials which are encountered during demolition, removal, or renovation projects and describes some of the resultant procedures and equipment required to protect workers and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of the generated asbestos containing materials. The asbestos work includes the removal of _____ _____ from _____ in building _____. This work does not require an asbestos permit from the state, and it is not required to be done by state accredited asbestos workers. This work does not involve friable asbestos, or non-friable asbestos that may become friable asbestos and therefore is a non-Regulated Asbestos Containing Material (non-RACM), as defined in 40 CFR 61, PART 61.

1.2 NCDEHNR ASBESTOS ACCREDITATION

Removal or demolition of non-RACM does not require the use of accredited personnel.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.58	(k) Asbestos, Tremolite, Anthophyllite, Actinolite
40 CFR 61, PART 61	NESHAPS; Asbestos NESHAP Revision; Final Rule
40 CFR 61, SUBPART M	National Emission Standard for Asbestos

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846	(Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II)

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal

Procedures."

SD-06 Test Reports

Asbestos Waste Shipment Record (DEHRN 3787)

Record and report, to the Contracting Officer, the amount of asbestos containing material removed and released for disposal. Deliver the report for the previous day at the beginning of each day shift with amounts of material removed during the previous day. The daily report shall show the linear feet or square feet removed. Use the "Asbestos Waste Shipment Record (DEHRN 3787) for this report.

PART 2 PRODUCTS

2.1 DISPOSAL BAGS

Bags shall be a minimum of 6 mil thick polyethylene. Affix a warning and Department of Transportation (DOT) label to each bag or use bags with the approved warnings and DOT labeling preprinted on the bag.

2.2 PLASTIC SHEET

Plastic sheet, polyethylene, 6 mil minimum thickness, unless otherwise specified, in sizes to minimize the frequency of joints. Affix warning labels to the plastic sheet used to line trucks and transportation containers.

2.3 TAPE

Capable of sealing joints of adjacent sheets or plastic sheets and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under dry and wet conditions, including use of amended water.

2.4 WARNING LABELS

Provide labels conforming to 29 CFR 1926.58(k) of sufficient size to be clearly legible, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING ASBESTOS DUST MAY
CAUSE SERIOUS BODILY HARM

PART 3 EXECUTION

3.1 DISPOSAL SITE

Base Sanitary Landfill shall be used for disposal of all asbestos waste. The Base Sanitary Landfill is approved and is available for use by the Contractor providing the following requirements are satisfied:

a. The Contracting Officer must be informed at least five working days in advance of the anticipated delivery date of the asbestos material to the Landfill. On larger projects, the notification

should be accompanied by a cubic yard estimate of the anticipated volume, updated weekly if the disposal period extends for more than one week. The Government will be responsible for digging the trenches and covering the debris atthe end of the working day.
Debris will not be accepted before 9:00 am or after 2:00 pm, except in an emergency situation. All off loading of asbestos waste must be finished by 2:00 pm.

b. Asbestos disposal is restricted to one designated location in the Landfill and the landfill operators must be informed of and direct each delivery. Asbestos shall be disposed of from 0800 to 1000 hours daily, except weekends and holidays. Trucks hauling asbestos must be properly covered with tarpaulins or equivalent. Trucks not covered properly must be parked until the Contracting Officer approves corrective actions.

c. The Contractor will ensure asbestos contaminated material delivered to the Base Sanitary Landfill contains no free liquids. Free liquids are defined as material which fails the EPA SW-846 free liquids test.

d. The Contractor shall have a completed manifest (DEHRN 3787), a Contractor's pass, and a copy of the cover sheet of the contract.

e. When dumping large loads of non-friable asbestos containing material, a sheet of plastic must be laid in the trench, the load dumped on top of the plastic and then the plastic must be wrapped over top of the load and sealed.

3.2 NON-FRIABLE ASBESTOS REMOVAL PROCEDURES

Work procedures that will cause dust and airborne asbestos fibers to be released will not be permitted. Grinding, sawing, and other abrasive operations are not permitted. Bound material such as built up roofing may be cut with knives, axes, hatchets, and similar tools. Pliable material such as sealants may be scraped and/or dissolved with solvents. Contaminated tools may be cleaned for reuse or disposed of in the Landfill. Contaminated building material and cleaning material shall be placed in asbestos marked bags and disposed of in the Landfill. Procedure for hauling and disposal shall comply with 40 CFR 61, SUBPART M, state and local standards.

3.2.1 Built-Up Roofing

Roofing felts coated with bitumens may be cut to remove from the roof and placed in a plastic sheet double lined truck or container for transportation. Container shall be leak tight. Cover with plastic sheet before hauling to the Landfill. It is recommended that rope be wrapped around large loads to keep the bundle from breaking apart while dumping. Transport to the Base Sanitary Landfill and dispose of in the asbestos section.

3.2.2 Sealant

Scrape sealant from metal roofing and siding using hand tools that do not grind or abrade. Place removed material in solvent and place material in double bags. Remove remaining residual sealant with solvent and place material and any rags in the double disposal bags. Seal the bags with duct

tape and transport to the Base Sanitary Landfill. Dispose of material in the asbestos section of the Landfill.

3.2.3 Flexible Duct Connections

Remove the flexible duct connector from the ductwork by unfastening the metal flange(s-lock) on either side. Do not cut or tear the fabric. Fold the connector and place in double disposal bags. Seal the bags with duct tape and transport to the Base Sanitary Landfill. Dispose of the material in the asbestos section of the landfill.

-- End of Section --

SECTION 02 82 18

REMOVAL AND DISPOSAL OF ASBESTOS MATERIALS FOR DEPENDENT SCHOOLS
(CAMP LEJEUNE COMPLEX)

01/07

PART 1 GENERAL

1.1 APPLICABLE NORTH CAROLINA LAW

North Carolina State General Statues and Regulation under Title 15 N.C. Administrative Chapter 2D .0525 and 10NCAC 7C .0601 through .0607 apply to all work under this Contract.

1.1.1 NCDEHNR Asbestos Accreditation

All personnel involved in asbestos removal shall be currently accredited for asbestos removal by NCDEHNR. An application for accreditation may be requested from the State of North Carolina, Department of Environment, Health, and National Resources, Asbestos Branch, P.O. Box 27687, Raleigh, NC, 27611-7687, telephone (919) 733-0820. Out of State accreditation will not be accepted.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z88.2	(1992) Respiratory Protection

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 732	(1995) Aging Effects of Artificial Weathering on Latex Sealants
ASTM D 1331	(1989; R 1995) Surface and Interfacial Tension of Solutions of Surface-Active Agents
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1997; Rev A) Water Vapor Transmission of Materials
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed

	Fire-Resistive Materials Applied to Structural Members
ASTM E 1368	(1997) Visual Inspection of Asbestos Abatement Projects

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.103	Respiratory Protection
29 CFR 1910.51	Sanitation
29 CFR 1926.59	Hazard Communication
29 CFR 1926.1101	Asbestos
40 CFR 61, SUBPART A	General Provisions
40 CFR 61, SUBPART M	National Emission Standard for Asbestos
40 CFR 763	Friable Asbestos Containing Material in Schools

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 560/5-85-024	(1985) Guidance for Controlling Asbestos Containing Materials in Buildings
EPA SW-846	(Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II)

U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

ND OPNAVINST 5100.23	(Rev. D) Navy Occupational Safety and Health (NAVOSH) Program Manual

UNDERWRITERS LABORATORIES (UL)

UL 586	(1996; Rev thru Aug 1999) High-Efficiency, Particulate, Air Filter Units

1.3 DEFINITIONS

1.3.1 ACM

Asbestos Containing Materials.

1.3.2 Action Level

An airborne concentration of asbestos fibers, in the breathing zone of a worker equaling 0.1 fibers per cubic centimeter of air calculated as an 8-hour time weighted average.

1.3.3 Amended Water

Water containing a wetting agent or surfactant with a surface tension of 29 dynes per square centimeter when tested in accordance with ASTM D 1331.

1.3.4 Area Sampling

Sampling of asbestos fiber concentrations within the asbestos control area and outside the asbestos control area which approximates the concentrations of asbestos in the theoretical breathing zone but is not actually collected in the breathing zone of an employee.

1.3.5 Asbestos

The term asbestos includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite and any of these minerals that has been chemically treated or altered. Materials are considered to contain asbestos if the asbestos content is at least one percent of the material by area.

1.3.6 Asbestos Control Area

That area where asbestos removal operations are performed which is isolated by physical boundaries which assist in the prevention of the uncontrolled release of asbestos dust, fibers, or debris. Two examples of an asbestos control area are: a full containment and a "glovebag."

1.3.7 Asbestos Fibers

Those fibers having an aspect ratio of at least 3:1 and longer than 5 micrometers as determined by National Institute for Occupational Safety and Health (NIOSH) Method 7400.

1.3.8 Asbestos Permissible Exposure Limit

0.1 fibers per cubic centimeter of air as an 8-hour time weighted average as defined by 29 CFR 1926.1101 or other federal legislation having legal jurisdiction for the protection of workers health.

1.3.9 Background

Normal airborne asbestos concentration in an area similar to the asbestos abatement area but in an uncontaminated (with asbestos) state.

1.3.10 Contractor

The Contractor is that individual, or entity under contract to the Navy to perform the herein listed work.

1.3.11 Encapsulants

Specific materials in various forms used to chemically entrap asbestos fibers in various configurations to prevent these fibers from becoming airborne. There are four types of encapsulants as follows which must comply with performance requirements as specified herein.

a. Removal Encapsulant (can be used as a wetting agent)

b. Bridging Encapsulant (used to provide a tough, durable surface coating to asbestos containing material)

c. Penetrating Encapsulant (used to penetrate the asbestos containing material down to substrate, encapsulating all asbestos fibers)

d. Lock-Down Encapsulant (used to seal off or "lock-down" minute asbestos fibers left on surfaces from which asbestos containing material has been removed)

1.3.12 Friable Asbestos Material

Material that contains more than one percent asbestos by area and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

1.3.13 Full Containment

Those engineering control techniques described in 29 CFR 1926.1101 for major asbestos removal, renovation and demolition operations.

1.3.14 Glovebag Technique

Those asbestos removal and control techniques put forth in 29 CFR 1926.1101.

1.3.15 HEPA Filter Equipment

High efficiency particulate air (HEPA) filtered vacuum and/or exhaust ventilation equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall retain 99.97 percent of particles 0.3 microns or larger as indicated in UL 586.

1.3.16 Navy Industrial Hygienist (NIH)

That industrial hygienist employed by the Navy to monitor, sample, and/or inspect the work separate from the original construction contract. The NIH can be either a Federal civil servant or a private consultant as determined by the Navy. In some instances the NIH shall perform assigned duties vicariously through a trained subordinate but only with the specific consent of the Contracting Officer.

1.3.17 Nonfriable Asbestos Material

Material that contains asbestos in which the fibers have been temporarily locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not normally release asbestos fibers during any appropriate use, handling, storage or transportation. It is understood that asbestos fibers will be released under other conditions such as demolition or removal.

1.3.18 Personal Sampling

Air sampling to determine asbestos fiber concentrations within the breathing zone of a specific employee, performed in accordance with 29 CFR 1926.1101.

1.3.19 Supervising Air Monitor (SAM)

That supervising aiar monitor hired by the Contractor to perform the herein listed industrial hygiene tasks. In some instances, the SAM can perform this role vicariously through a trained subordinate, but only with the specific consent of the Contracting Officer.

1.3.20 TEM

Refers to Transmission Electron Microscopy

1.3.21 Time Weighted Average (TWA)

The TWA is an 8-hour time weighted average airborne concentration of asbestos fibers. At least three full shift samples per person are required to establish that person's TWA exposure.

1.3.22 Wetting Agent

That specific agent used to reduce airborne asbestos levels by physically bonding asbestos fibers to material to be removed. An equivalent wetting agent must have a surface tension of at least 29 dynes per square centimeter as tested in accordance with ASTM D 1331.

1.4 REQUIREMENTS

1.4.1 Description of Work

The work covered by this section includes the handling of asbestos containing materials which are encountered during repair, construction and demolition projects and describes some of the resultant procedures and equipment required to protect workers and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of the generated asbestos containing materials. More specific operational procedures will be outlined in the Asbestos Hazard Abatement Plan called for elsewhere in this specification. The asbestos work includes the demolition and removal of _____ located _____ which is governed by 40 CFR 763. Under normal conditions non-friable or chemically bound materials containing asbestos would not be considered hazardous; however, this material will release airborne asbestos fibers during demolition and removal and therefore must be handled in accordance with the removal and disposal procedures as specified herein. Provide full containment, glovebag, outdoor techniques as outlined in this specification.

1.4.2 Medical Requirements

29 CFR 1926.1101.

1.4.2.1 Medical Examinations

Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1926.1101 or other pertinent state or local directives. This requirement must have been satisfied within the past year. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. Specifically identify x-ray films of asbestos workers to the consulting radiologist and mark medical record jackets with the word "ASBESTOS."

1.4.2.2 Medical Records

Maintain complete and accurate records of employees' medical examinations, medical records, and exposure data for a period of 50 years after termination of employment and make records of the required medical examinations and exposure data available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health (OSHA), or authorized representatives of them, and an employee's physician upon the request of the employee or former employee.

1.4.3 Training

All personnel working in the asbestos field are required to receive train ing necessary to obtain accreditation for asbestos removal in the state of North Carolina.

1.4.4 N. C. Department of Environment, Health, and Natural Resources (NCDEHNR)

File the "Notice of Demolition and/or Renovation Involving Asbestos Removal." Obtain necessary permists in conjunction with asbestos removal, hauling, and disposition, and furnish timely notification of such actions required by federal, state, regional, and local authorities. Notify the NCDEHNR and the Contracting Officer in writing 20 days prior to the commencement of work in accordance with 40 CFR 61, SUBPART A and 40 CFR 61, SUBPART M. Submit a copy of the permit to the Contracting Officer.

1.4.4.1 NCDEHNR mailing address is:

N. C. Department of Environment, Health, and Natural Resources
Asbestos Branch
P.O. Box 27687
Raleigh, NC 27611-7687

1.4.4.2 "ASBESTOS PERMIT APPLICATION AND NOTIFICATION (DEHNR 3768)"

Shall also be submitted in accordance with State Regulations. When DEHNR approval is obtained, a copy of the approved permit shall be submitted to the Contracting Officer.

1.4.4.3 Changes in Work

Changes in Work which affect items on the attached form shall be covered by an amended form submitted to the same address.

1.4.5 Safety and Health Compliance

In addition to detailed requirements of this specification, comply with those applicable laws, ordinances, criteria, rules, and regulations of federal, state, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.1101, 40 CFR 61, SUBPART A, 40 CFR 61, SUBPART M, and ND OPNAVINST 5100.23. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification, applicable laws, rules, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirement as defined by the Contracting Officer shall apply.

1.4.6 Respiratory Protection Program

Establish and implement a respirator program as required by ANSI Z88.2 and 29 CFR 1910.103.

1.4.7 Supervising Air Monitor (SAM)

Conduct personal area/environmental air sampling and training under the

direction of a North Carolina accrediated supervising air monitor. For the purpose of this contract, the Contractor shall retain the services of a SAM to perform the Contractor's industrial hygiene tasks.

1.4.8 Hazard Communication

Adhere to all parts of 29 CFR 1926.59 and provide the Contracting Officer with a copy of the Material Safety Data Sheets (MSDS) for all materials brought to the site.

1.5 SUBMITTALS

Submit 4 copies of the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-03 Product Data

Local exhaust equipment

Vacuums

Respirators

Pressure differential automatic recording instrument

Amended water

Glovebag

Material Safety Data Sheets (MSDS) for all materials proposed for transport to the project site

SD-06 Test Reports

Air sampling results

Pressure differential recordings for local exhaust system

Clearance sampling

SD-07 Certificates

Asbestos hazard abatement plan (Abatement Design)

Testing laboratory

Supervising Air Monitor (SAM) & NC Accrediation

Employee Accreditation

Medical certification

Vacuums

Water filtration equipment

Ventilation systems

Other equipment required to contain airborne asbestos fibers

Chemical encapsulants/sealers

Show compliance with ANSI Z9.2 by providing manufacturers' certifications.

SD-11 Closeout Submittals

Notifications

Rental equipment

Respirator program records

Asbestos Waste Shipment Record (DEHNR 3787)

Daily log

Preliminary North Carolina permit application and NEESHAP's notification

North Carolina permit

Modifications to the North Carolina permit

Asbestos Inspection Reporting Form

Response action completion report.

Asbestos Free Certification

1.5.1 Asbestos Hazard Abatement Plan (NC Abatement Design)

Submit a detailed plan of the safety precautions and work procedures to be used in the removal and demolition of materials containing asbestos. The plan shall be prepared, signed, and sealed, including accrediation number and date, by an accrediated abatement designer. The respirator program and air monitoring strategies portion of this plan shall be prepared by the supervising air monitor. Such plan shall include but not be limited to the precise personal protective equipment to be used, the location of asbestos control areas including clean and dirty areas, buffer zones, showers, storage areas, change rooms, removal method, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos sealer to be used, locations of local exhaust equipment, planned air monitoring strategies, and a detailed description of the method to be employed in order to control pollution. The plan shall also include (both fire and medical emergency) response plans. This plan must be approved in writing prior to the start of any asbestos work. The Contractor and disigner shall meet with the Contracting Officer prior to beginning work, to discuss in detail the asbestos plan, including work procedures and safety precautions. Once approved by the Contracting Officer, the plan will be enforced as if an addition to the specification. Any changes required in the specification as a result of the plan shall be identified specifically in the plan to allow for free discussion and approval by the Contracting Officer prior to the start of work. The plan shall comply with all federal and state requirements and this specification, ans shall serve as the North Carolina Abatement Design.

1.5.2 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected for the sampling, analysis, and reporting of airborne concentrations of asbestos fibers along with certification that persons counting the samples have been judged proficient by successful participation within the last year in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program. Where analysis to determine asbestos content in bulk materials is required, submit evidence that the laboratory is accredited by the National Institute of Science and Technology (NIST) under National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis.

1.5.3 Supervising Air Monitor(SAM)

Submit the name, address, and telephone number of the supervising air monitor selected to direct monitoring. Personnel performing any industrial hygiene function under the direction of the SAM shall be employed by the SAM's company.

1.5.4 Employee Accreditation

Submit certificates of NC accreditation.

1.5.5 Medical Certification

Provide a written certification signed by a licensed physician that all workers and supervisors have met or exceeded all of the medical prerequisites listed herein and in 29 CFR 1926.1101 and 29 CFR 1910.103.

1.5.6 Air Sampling Results

Complete fiber counting and provide results to the SAM for review within 16 hours. Notify the Contracting Officer immediately of any airborne levels of asbestos fibers in excess of the acceptable limits. Submit sampling results to the Contracting Officer and the affected Contractor employees within 3 working days, signed by the employee performing air sampling, the employee that analyzed the sample, and the SAM.

1.5.7 Pressure Differential Recordings for Local Exhaust System

Provide a local exhaust system that creates a negative pressure of at least 0.02 inches of water relative to the pressure external of the enclosure and operate it continuously, 24 hours a day, until the enclosure of the asbestos control area is removed. Provide continuous 24-hour per day monitoring of the pressure differential with a pressure differential automatic recording instrument. Submit pressure differential recordings for each work day to the SAM for review and to the Contracting Officer within 24 hours from the end of each work day. Notify the Contractor and the Contracting Officer immediately of any variance in the pressure differential which could cause adjacent unsealed areas to have asbestos fiber concentrations in excess of 0.01 fibers per cubic centimeter or background whichever is higher. In no circumstance shall levels exceed 0.1 fibers per cubic centimeter.

1.5.8 Notifications

Notify the Contracting Officer in writing 10 working days prior to the start of asbestos work. Notify the local fire department 3 days prior to

removing fire-proofing material from the building including notice that the material contains asbestos.

1.5.9 Rental Equipment

Provide a copy of the written notification to the rental company concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

1.5.10 Respirator Program Records

29 CFR 1910.103, 29 CFR 1926.1101.rogram as required by ANSI Z88.2,

1.5.11 Asbestos Waste Shipment Record (DEHNR 3787)

Record and report, to the Contracting Officer, the amount of asbestos containing material removed and released for disposal. Deliver the report for the previous day at the beginning of each day shift with amounts of material removed during the previous day reported in linear feet or square feet as described initially in this specification and in cubic feet for the amount of asbestos containing material released for disposal. Use "Asbestos Waste Shipment Record (DEHNR 3787) for this report.

1.5.12 Daily Log

A daily log documenting work practices, sample locations, and all other asbestos related job conditions shall be maintained, by the testing lab and be available for Government examination throughout the course of work. At the completion of testing, a copy of this log shall be immediately delivered to the Government.

1.5.13 Preliminary North Carolina Permit Application

Submit the North Carolina Permit Application to the Contracting Officer along with the Abatement Plan. It shall be completed, except for removal dates and signature. The Permit Application may be submitted to the State before or after submittal to the Contracting Officer. The Contractor is responsible for proper application and for the obtaining of the permit from the State.

1.5.14 North Carolina Permit

Submit one copy of the North Carolina Permit before beginning abatement activities.

1.5.15 Modifications to the North Carolina Permit

Submit a copy of all permit modifications to the Contracting Officer. These must be received before they become effective. The Contractor is responsible for proper permit modification notification to the State. Modifications may be delivered to the Contracts Office or transmitted by facsmile to (910) 411-5899.

1.5.16 Asbestos Inspection Reporting Form

This Asbestos Inspection Reporting Form is included at the end of this section and shows the homogeneous areas involved with this project. The Contractor shall mark the line "confirmed ACM from this HA:" as either "Abated" or "Managed in Place." Abated shall be defined as removed. If an

HA is partially abated, approximate the percentaged of asbestos removed and mark in the comments area. Provide any other descriptive data, such as rooms/areas removed or rooms/areas where asbestos not removed. The intent of this requirement is to report "as built" conditions. The Contractor is not required to perform any additional asbestos surveys or inspections as a result of this paragraph.

1.5.17 Response Action Completion Report

Submit in accordance with 40 CFR 763. Include type, amount, location, and dates of material removed. Report shall be certified to be true and signed, include accrediation category and number. Response action completion report shall include a certification from each supplier that material supplied for this project is asbestos free.

1.5.18 Asbestos Free Certification

Certification that material is asbestos free. Submit with other submittals of this section and include in Section 02 82 16, "Response Action Completion Report".

1.6 ASBESTOS INSPECTION REPORTING FORM AND ASBESTOS SAMPLE REPORTING FORM

These two forms are included at the end of this section for informational purposes. They do not define or modify the scope of work.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Shall conform to current USEPA requirements, shall contain no toxic or hazardous substances as defined in 29 CFR 1926.59, and shall conform to the following performance requirements.

2.1.1 Removal Encapsulants

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Life Expectancy - 20 years	ASTM C 732, Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E 96

2.1.2 Lock-down Encapsulant

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Life Expectancy - 20 years	ASTM C 732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E 96

Requirement	Test Standard
Fire Resistance - Negligible affect on fire resistance rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	ASTM E 119
Bond Strength - 100 pounds of force/ foot (Tests compatibility with cementitious and fibrous fire-proofing)	ASTM E 736

2.1.3 Plastic Sheet

Plastic sheet, polyethylene, 6 mil minimum thickness, unless otherwise specified, in sizes to minimize the frequency of joints.

2.1.4 Tape

Capable of sealing joints of adjacent sheets or plastic sheets and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under dry and wet conditions, including use of amended water.

PART 3 EXECUTION

3.1 DISPOSAL SITE

Base Sanitary Landfill shall be used for disposal of all asbestos waste. The Base Sanitary Landfill is approved and is available for use by the Contractor providing the following requirements are satisfied:

a. The Contracting Officer must be informed at least five working days in advance of the anticipated delivery date of the asbestos material to the Landfill. On larger projects, the notification should be accompanied by a cubic yard estimate of the anticipated volume, updated weekly if the disposal period extends for more than one week. The Government will be responsible for digging the trenches and covering the debris at the end of the working day. Debris will not be accepted before 8:00 AM or after 10:00 AM, except in an emergency situation.

b. Asbestos will be accepted only if double bagged in heavy-duty plastic bags which are clearly marked "Asbestos." If a Contractor desires to handle the asbestos in a manner other than double-bagged, written application, along with a description of the proposed deviation, must be submitted to the ROICC for approval.

c. Asbestos insulated piping with the asbestos insulation intact will be accepted if the following requirements are met:

1. The pipe is cut in eight foot or shorter lengths

2. Each section of pipe is double wrapped, sealed, and labeled as asbestos.

3. All pipe is palletized on a 7/8-inch, 4- by 8-foot sheet of

plywood. The whole pallet is banded with a minimum of three 1-inch wide metal bands with the coupling on top and wrapped with 6-mil plastic. The pallet is not higher than 3-inches.

d. All asbestos, except palletized pipe will be off loaded and placed in the trench pipe hand.

e. Asbestos disposal is restricted to one designated location in the Landfill and the landfill operators must be informed of and direct each delivery. Asbestos shall be disposed of from 0800 to 1000 hours daily, except holidays and weekends. Trucks hauling asbestos must be properly covered with tarpaulins or equivalent. Trucks not covered properly must be parked until the Contracting Officer approves corrective actions.

f. The Contractor will ensure asbestos contaminated material delivered to the Base Sanitary Landfill contain no free liquids. Free liquids are defined as material which fails the EPA SW-846 free liquids test.

3.2 EQUIPMENT

Make available to the Contracting Officer or the Contracting Officer's Representative, two complete sets of personal protective equipment as required herein for entry to the asbestos control area at all times for inspection of the asbestos control area. Provide equivalent training to the Contractor employees in the use of the required personal protective equipment. Provide manufacturer's certificate of compliance for all equipment required to contain airborne asbestos fibers.

3.2.1 Respirators

Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

3.2.1.1 Respirators for Handling Asbestos

Provide personnel engaged in the removal and demolition of asbestos materials with Type C supplied-air respirators, in the pressure/demand mode with an auxiliary self contained breathing apparatus. The use of any other type of respiratory protection must be requested in writing by the SAM. The request shall identify the specific type of respiratory protection requested and the reasoning behind the choice. Forward the request to the Contracting Officer who will consult with the NIH and provide a written response to the request. A different request shall be filed for each type of operation. All respiratory protection shall comply with the spirit and letter of 29 CFR 1926.1101 and 29 CFR 1910.103. Use of other than Type C supplied-air respirators, in the pressure/demand mode with an auxiliary self contained breathing apparatus is prohibited unless approved by the Contracting Officer.

3.2.2 Exterior Whole Body Protection

3.2.2.1 Protective Clothing

Provide personnel exposed to asbestos with disposable protective whole body clothing, head coverings, gloves, and foot coverings. Provide disposable

plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort, but shall not be used alone. Make sleeves secure at the wrists, make foot coverings secure at the ankles, and make clothing secure at the neck by the use of tape.

3.2.2.2 Work Clothing

Cloth work cloths may be worn under the disposable protective coveralls and foot coverings. If they are worn they must be either disposed of as contaminated or properly laundered as recommended by the SAM after use. If laundering is to be used then SAM recommendations shall be made a part of the Asbestos Hazard Abatement Plan.

3.2.2.3 Decontamination Unit

Provide a temporary, negative pressure unit with a separate decontamination locker room and a clean locker room with a shower that complies with 29 CFR 1910.51(d)(3) in between for personnel required to wear whole body protective clothing. Provide two separate lockers for each asbestos worker, one in each locker room. Keep street clothing and street shoes in the clean locker. HEPA vacuum and remove asbestos contaminated disposable protective clothing while still wearing respirators at the boundary of the asbestos work area and seal in impermeable bags or containers for disposal. Do not wear work clothing between home and work. Locate showers between the decontamination locker room and the clean locker room and require that all employees shower before changing into street clothes. Collect used shower water and filter to remove asbestos contamination with an approved water filtration equipment of at least 0.5 micron particle size collection capabilities. Dispose of filters and residue as asbestos waste. Discharge clean water to the sanitary system. Dispose of asbestos contaminated work clothing as asbestos contaminated waste. Decontamination units shall be physically attached to the asbestos control area. Build both a personnel decontamnation unit and an equipment decontamination unit onto and integral with each asbestos control area. Bagged asbestos debris shall not be loaded out throught the personal decontamination unit.

3.2.2.4 Eye Protection

Provide goggles to personnel engaged in asbestos operations when the use of a full face respirator is not required.

3.2.3 Warning Signs and Labels

Provide warning signs printed in English and at all approaches to asbestos control areas containing concentrations of airborne asbestos fibers. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

3.2.3.1 Warning Sign

Provide vertical format conforming to 29 CFR 1926.1101 minimum 20 by 14 inches displaying the following legend in the lower panel:

Legend	Notation
Danger	1-inch Sans Serif Gothic or Block

Legend	Notation
Asbestos	1-inch Sans Serif Gothic or Block
Cancer and Lung Disease Hazard	1/4-inch Sans Serif Gothic or Block
Authorized Personnel Only	1/4-inch Gothic
Respirators and Protective Clothing are Required in this Area	1/4-inch Gothic

Spacing between lines shall be at least equal to the height of the upper of any two lines.

3.2.3.2 Warning Labels

Provide labels conforming to 29 CFR 1926.1101 of sufficient size to be clearly legible, displaying the following legend:

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

BREATHING ASBESTOS DUST MAY

CAUSE SERIOUS BODILY HARM

3.2.4 Local Exhaust System

Provide a local exhaust system in the asbestos control area in accordance with ANSI Z9.2 and 29 CFR 1926.1101 that will provide at least four air changes per hour inside of the containment. Local exhaust shall be operated 24 hours per day, until the asbestos control area is removed and shall be leak proof to the filter and equipped with HEPA filters. Local exhaust equipment shall be sufficient to maintain a minimum pressure differential of minus 0.02 inch of water column relative to adjacent, unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential with a pressure differential automatic recording instrument. In no case shall the building ventilation system be used as the local exhaust system for the asbestos control area. Filters on exhaust equipment shall conform to ANSI Z9.2 and UL 586. The local exhaust system shall terminate out of doors.

3.2.5 Tools

Vacuums shall be leak proof to the filter and equipped with HEPA filters. Filters on vacuums shall conform to ANSI Z9.2 and UL 586. Do not use power tools to remove asbestos containing materials unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation systems. Remove all residual asbestos from reusable tools prior to storage or reuse.

3.3 WORK PROCEDURE

Perform asbestos related work in accordance with 29 CFR 1926.1101 and as specified herein. Use wet removal procedures and full containment, glovebag, outdoor techniques. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, drinking, or applying cosmetics shall not be permitted in the asbestos work or control areas. Personnel of other trades not engaged in the removal and demolition of asbestos shall not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection provisions of this specification are complied with by the trade personnel. Shut down the building heating, ventilating, and air conditioning system, cap the openings to the system, and provide temporary heating, and ventilation, and air conditioning prior to the commencement of asbestos work. Disconnect electrical service when wet removal is performed and provide temporary electrical service prior to the use of any water. If an asbestos spill occurs outside of the asbestos control area, stop work immediately, correct the condition to the satisfaction of the Contracting Officer including clearance sampling, prior to resumption of work.

3.3.1 Protection of Existing Work to Remain

Perform demolition work without damage or contamination of adjacent work. Where such work is damaged or contaminated as verified by the Contracting Officer using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government as deemed appropriate by the Contracting Officer. This includes inadvertent spill of dirt, dust, or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, stop work immediately. Then clean up the spill. When satisfactory visual inspection and air sampling results are obtained from the SAM work may proceed.

3.3.2 Furnishings

Furniture and equipment will be removed from the area of work by the Government before asbestos work begins.

Furniture and equipment will remain in the building. Cover and seal furnishings with 6-mil plastic sheet or remove from the work area and store in a location on site approved by the Contracting Officer.

Furnishings listed below and located in the work area are considered to be contaminated with asbestos fibers. Transfer these items to an area on site approved by the Contracting Officer, decontaminate (wet methods where possible), and then store until the room from which they came is declared clean and safe for entry. Carpets, draperies, and other items which may not be suitable for on-site wet cleaning methods shall be properly laundered as recommended by the SAM so as to remove all asbestos contamination or disposed of at the Contracting Officer's discretion. At the conclusion of the asbestos removal work and cleanup operations, transfer all objects so removed and cleaned back to the area from which they came and re-install them. Base bids on decontaminating:

a. Desks

b. Filing cabinets

c. Linear feet of shelving

d. Cubic Feet of books, papers, files, etc.

3.3.3 Precleaning

Wet wipe and HEPA vacuum all surfaces with asbestos debris prior to establishment of a containment.

3.3.4 Asbestos Control Area Requirements

3.3.4.1 Full Containment For Description of Area or Material

Block and seal openings in areas where asbestos removal is to take place. Establish an asbestos containment with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos work area. Containment development shall include protective covering of walls, and ceilings with a continuous membrane of two layers of minimum 4-mil plastic sheet sealed with tape to prevent water or other damage. Provide two layers of 6-mil plastic sheet over floors and extend a minimum of 12 inches up walls. Seal all joints with tape. Provide local exhaust system in the asbestos control area. Openings will be allowed in enclosures of asbestos control areas for the supply and exhaust of air for the local exhaust system. Replace filters as required to maintain the efficiency of the system.

3.3.4.2 Glovebag

The construction of an enclosed asbestos containment is infeasible for the removal of _____ located _____. Use glovebag techniques as indicated in 29 CFR 1926.1101 Appendix G, III-A, B, C, D and Figure G-1. Establish designated limits for the asbestos work area with the use of rope or other continuous barriers, maintain all other requirements for asbestos controlareas except for local exhaust.

3.3.4.3 Outdoor

The construction of an enclosed asbestos containment is infeasible for the removal of _____ located _____. Establish designated limits for the asbestos work area with the use of rope or other continuous barriers, and maintain all other requirements for asbestos control areas except for local exhaust.

3.3.4.4 Asbestos Control Area Requirement For Floor Tile

Seal openings in areas where the release of airborne asbestos fibers is expected. Prior to commencing asbestos demolition and removal procedures, establish an asbestos control area with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos control area. The established control area shall be provided with protective covering of walls to 101-inches continuous membrane of one layer of minimum 4-mil plastic sheet sealed with tape to prevent water or other damage. Seal joints with tape. Openings will be allowed in enclosures of asbestos control areas for the supply of air for the local exhaust system. A HEPA exhaust is required for all friable removals.

3.3.5 Asbestos Handling Procedures

3.3.5.1 General Procedures

Wet asbestos material with a fine spray of amended water or specific wetting agent during removal, cutting, or other handling so as to reduce the emission of airborne fibers. Remove material and immediately place in 6 mil plastic disposal bags. Where unusual circumstances prohibit the use of 6 mil plastic bags, submit an alternate proposal for containment of asbestos fibers to the Contracting Officer for approval. For example, in the case where both piping and insulation are to be removed, the Contractor may elect to wet the insulation and wrap the pipes and insulation in plastic and remove the pipe by sections.

3.3.5.2 Sealing Contaminated Items Designated for Disposal

Remove contaminated architectural, mechanical, and electrical appurtenances such as venetian blinds, full-height partitions, carpeting, duct work, pipes and fittings, radiators, light fixtures, conduit, panels, and other contaminated items designated for removal by completely coating the items with an asbestos lockdown encapsulant at the demolition site before removing the items from the asbestos control area. These items need not be vacuumed. The asbestos lockdown encapsulant shall be tinted a contrasting color. It shall be spray-applied by airless method. Thoroughness of sealing operation shall be visually gauged by the extent of colored coating on exposed surfaces. Lockdown encapsulants shall comply with the performance requirements specified herein.

3.3.5.3 Exposed Pipe Insulation Edges

Contain edges of asbestos insulation to remain that are exposed by a removal operation. Wet and cut the rough ends true and square with sharp tools and then encapsulate the edges with a 1/4-inch-thick layer of non-asbestos containing insulating cement troweled to a smooth hard finish. When cement is dry, lag the end with a layer of non-asbestos lagging cloth, overlapping the existing ends by 4 inches. When insulating cement and cloth is an impractical method of sealing a raw edge of asbestos, take appropriate steps to seal the raw edges as approved by the Contracting Officer.

3.3.5.4 Pipe Insulation

Pipe may be removed with the asbestos insulation in place by wrapping the entire length of pipe and associated insulation with double thickness 6 mil plastic secured with duct tape. Cut insulation and piping simultaneously into lengths suitable for transportation to disposal area, but no greater than 8 feet in length. Continuously wet the cutting site during the process. As soon as a length of pipe is completely cut loose, cover exposed ends with double thickness 6 mil plastic secured with duct tape. If the pipe is to remain in service, the removed pipe must be replaced in accordance with this Specification, with a pipe of the same size that is removed.

3.3.5.5 Attic Insulation

In those buildings indicated on the drawings, attic insulation consisting of any combination of blown-in or batt fiberglass or rockwool material, has been contaminated with asbestos materials, and is to be removed as contaminated asbestos material. The insulation material shall be wet with

a fine mist of amended water. The material shall be placed immediately in double thickness 6 mil plastic bags for disposal as asbestos waste.

3.3.5.6 Contaminated Soil

In those buildings so indicated on the drawings, asbestos materials are located in the building crawl spaces and deterioration of the asbestos material has resulted in contamination of the soil under the building. Under the indicated area of these buildings, asbestos material and 2 inches of soil shall be removed and two sheets of plastic, 6 mils thick, spread over the area with seams lapped a minimum of 4 inches. Sand shall be placed a minimum of 2 inches thick over the plastic. Removal shall occur just prior to clean-up operations. All debris in the crawl space shall be disposed of with the soil as asbestos materials. Workers shall be equipped with respirators and protective clothing during the removal of soil and debris.

3.3.5.7 Non Friable Asbestos Procedures

Work procedures that will cause dust and airborne asbestos fibers to be released will not be permitted. Asbestos materials shall not be dropped, thrown, nor roughly handled, but shall be carefully handled during all stages of removal and carefully lowered or taken to ground level. All hand-operated and power tools used when working with nonfriable asbestos materials that could cause airborne asbestos fibers shall be provided with exhaust ventilation systems, in accordance wtih ANSI Z9.2 and 29 CFR 1926.1101. During removal, keep asbestos materials wet with water containing an approved wetting agent or surfactant. Wrecking, bulldozing, and similar operations will not be permitted during the removal of asbestos materials.

3.3.5.8 Handling of Contaminated Material

Handle asbestos-containing materials carefully and deliberately. Do not allow asbestos containing material to dry out or collect on the floors. As it is removed pack the material in containers for transport. Do not allow material to dry out prior to insertion into the container. Do not leave water-soaked fallen material out of bags overnight, or for more than four hours on hot days, to prevent loss of its water content due to evaporation. Mark bags and drums with the labels prescribed by the EPA, OSHA, or regulations referenced in these specifications. Clean the outside of all containers before leaving the work area.

3.3.5.9 Seal Filled Containers - Double Bagged

Place caution labels on containers in accordance with OSHA regulations 29 CFR 1926.1101. Clean external surfaces of containers thoroughly by wet sponging in the designated area of the owrk area which is part of the equipment decontamination enclosure system. Move containers to washroom, wet clean each container thoroughly, and move to holding area pending removal to uncontaminated areas. Ensure that containers are removed from the holding area by workers properly protected who have entered from uncontaminated areas dressed in clean overalls. Ensure that workers do not enter uncontaminated areas into the washroom or the work area without passing through the decontamination enclosure system. Ensure that contaminated works do not exit the work area through the equipment decontamination enclosure system.

3.3.6 Air Sampling

Sampling of airborne concentrations of asbestos fibers shall be performed in accordance with 29 CFR 1926.1101 and as specified herein. Sampling performed in accordance with 29 CFR 1926.1101 shall be performed by the SAM. Sampling performed for environmental and quality control reasons shall be performed by the SAM. Unless otherwise specified, use NIOSH Method 7400 for sampling and analysis. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those results obtained by the Contractor, the Government results shall prevail.

3.3.6.1 Sampling Prior to Asbestos Work

Provide area air sampling and establish the baseline one day prior to the masking and sealing operations for each removal site. Establish the background by performing area sampling in similar but uncontaminated sites in the building.

3.3.6.2 Sampling During Asbestos Work

The SAM shall provide personal and area sampling as indicated in 29 CFR 1926.1101 and governing environmental regulations. Thereafter, provided the same type of work is being performed, provide area sampling at least once every work shift close to the work inside the containment, outside the clean room entrance to the containment, and at the exhaust opening of the local exhaust system. Also, where an enclosure is not provided, conduct area monitoring of airborne asbestos fibers during the work shift at the designated limits downwind of the asbestos work area at such frequency as recommended by the SAM and conduct personal samples of each worker engaged in asbestos handling (removal, disposal, transport and other associated work). If the quantity of airborne asbestos fibers monitored at the breathing zone of the workers or designated limits at any time exceeds background or 0.01 fibers per cubic centimeter whichever is lesser, stop work, evacuate personnel in adjacent areas or provide personnel with approved protective equipment at the discretion of the Contracting Officer. This sampling may be duplicated by the government at the discretion of the Contracting Officer. If the air sampling results obtained by the government differ from those obtained by the Contractor, the government results shall prevail. If adjacent areas are contaminated as determined by the Contracting Officer, clean the contaminated areas, monitor, and visually inspect the area as specified herein.If sampling outside the containment shows airborne levels have exceeded background or 0.01 fibers per cubic centimeter, whichever is greater, stop all work, correct the condition(s) causing the increase, and notify the Contracting Officer immediately. In areas where the construction of a containment is not required, after initial TWAs are established and provided the same type of work is being performed, provide sampling at the designated limits of the asbestos work area at such frequency as recommended by the SAM. Where glovebag methods are used, perform personal and area air sampling at locations and frequencies thatwill accurately characterize the evolving airborne asbestos levels.

3.3.6.3 Sampling After Final Clean-Up (Clearance Sampling)

Provide area sampling of asbestos fibers using aggressive air sampling techniques as defined in the EPA 560/5-85-024 and establish an air borne asbestos concentration of less than 70 structures per square millimeter after final clean-up but before removal of the containment or the asbestos

work control area. After final cleanup and the asbestos control area is dry but prior to clearance sampling, the SAM shall perform a visual inspection, in accordance with ASTM E 1368, to insure that the asbestos control and work area is free of any accumulations of dirt, dust, or debris. Use transmission electron microscopy (TEM) to analyze clearance samples and report the results in accordance with current NIOSH criteria. The asbestos fiber counts from these samples shall be less than 70 structures per square millimeter or be not greater than the background, whichever is greater. Should any of the final samples indicate a higher value, the Contractor shall take appropriate actions to re-clean the area and shall repeat the sampling and TEM analysis at the Contractor's expense.

3.3.6.4 Sampling After Final Clean-Up (Clearance Sampling)

a. The Government may perform agressive area monitoring by TEM after surfaces have been thoroughly dried and establish the TWA of less than 70 structures/mm2 after final cleanup but before removal of the enclosure of the asbestos control area. The fiber counts from the samples shall be less than 70 structures/mm2 or statiscally equal to the air outside the containment. Should final samplings indicate a higher value, the Contractor shall reclean the area and be responsible to the Government for additional testing costs of $1,375. Allow 11 days for TEM final air clearance results.

b. The control zones shall be limited as indicated.

*Allow 5 days for TEM final air clearance in these two control zones

3.3.7 Lock Down

Prior to removal of plastic barriers and after pre-clearance clean up of gross contamination, a visual inspection by the SAM, of all areas affected by the removal of the asbestos contaminated materials for any visible fibers, shall be conducted and approved by the SAM. A post removal (lock down) encapsulant shall then be spray applied to ceiling, walls, floors and other areas exposed in the removal area. The exposed area shall include but not be limited to plastic barriers, furnishings and articles to be discarded as well as dirty change room, air locks for bag removal and decon chambers.

3.3.8 Site Inspection

While performing asbestos removal work, the Contractor shall be subject to on-site inspection by the Contracting Officer who may be assisted by or represented by safety or industrial hygiene personnel. If the work is found to be in violation of this specification, the Contracting Officer or his representative will issue a stop work order to be in effect immediately and until the violation is resolved. Standby time required to resolve the violation shall be at the Contractor's expense.

3.4 CLEAN-UP AND DISPOSAL

3.4.1 Housekeeping

Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Use HEPA filtered vacuum cleaners. Do not blow down the

space with compressed air. When asbestos removal is complete, all asbestos waste is removed from the work-site, final clean-up is completed, and final air sampling results are reported, the SAM will certify the area as safe and the Conrracting Officer will approve the abatement completion, before the signs can be removed. After final clean-up and acceptable airborne concentrations are attained but before the HEPA unit is turned off and the containment removed, remove all pre-filters on the building HVAC system and provide new pre-filters. Dispose of filters as asbestos-contaminated materials. Reestablish HVAC mechanical, and electrical systems in proper work ing order. The Contracting Officer will visually inspect all surfaces within the containment for residual material or accumulated dust or debris. The Contractor shall re-clean all areas showing dust or residual materials. If re-cleaning is required, air sample and establish an acceptable asbestos airborne concentration after re-cleaning. The SAM will provide written certification that the work area is safe within all standards as referenced within this contract before unrestricted entry is permitted. The Government shall have the option to perform monitoring to certify the areas are safe before entry is permitted.

3.4.2 Title to Materials

All materials resulting from demolition work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified in applicable local, state, and Federal regulations and herein.

3.4.3 Disposal of Asbestos

3.4.3.1 Procedure for Disposal

Collect asbestos waste, asbestos contaminated water, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing which may produce airborne concentrations of asbestos fibers and place in sealed fiberproof, waterproof, non-returnable containers (e.g. double plastic bags 6 mils thick, cartons, drums or cans). Wastes within the containers must be wetted to insure the security of the material in case of container breeching. Affix a warning and Department of Transportation (DOT) label to each bag or use at least 6 mil thick bags with the approved warnings and DOT labeling preprinted on the bag. For temporary storage, store sealed impermeable bags in asbestos waste drums or skids. An area for interim storage of asbestos waste-containing drums or skids will be assigned by the Contracting Officer or his authorized representative. Procedure for haul ing and disposal shall comply with 40 CFR 61, SUBPART M, state, regional, and local standards. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

3.4.3.2 Disposal Material Shall Contain No Free Liquid

The Contractor will ensure asbestos contaminated material delivered to the Base Sanitary Landfill contain no free liquids. Free liquids are defined as material which fails the EPA SW-846 Free Liquids Test.

-- End of Section --

SECTION 02 82 33.12

PREPARATION OF SURFACES COATED WITH CONTAMINATED PAINT

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z88.2	(1992) Respiratory Protection

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.57	Ventilation
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead Exposure in Construction
29 CFR 1926.103	Respiratory Protection
40 CFR 258	Disposal of Hazardous Materials
40 CFR 261	Identification and Listing of Hazardous Waste

UNDERWRITERS LABORATORIES (UL)

UL 586	(1996; Rev thru Aug 1999) High-Efficiency, Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8-hour period. As used in this section, "30 micrograms per cubic meter of air" refers to the action level.

1.2.2 Area Monitoring

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead

concentrations which may reach the breathing zone of personnel potentially exposed to lead.

1.2.3 Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area."

1.2.4 Certified Industrial Hygienist (CIH)

As used in this section, refers to an Industrial Hygienist employed by the Contractor and is certified by the American Board of Industrial Hygiene in comprehensive practice.

1.2.5 Change Rooms and Shower Facilities

Rooms within the designated physical boundary around the lead control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevent cross-contamination.

1.2.6 Decontamination Room

Room for removal of contaminated personal protective equipment (PPE).

1.2.7 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead averaged over an 8-hour workday to which an employee is exposed.

1.2.8 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron size particles.

1.2.9 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.

1.2.10 Lead Control Area

An enclosed area or structure with full containment to prevent the spread of lead dust, paint chips, or debris of lead-contaminated paint removal operations. The lead control area is isolated by physical boundaries to prevent unauthorized entry of personnel.

1.2.11 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8-hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than 8 hours in a work day, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.12 Personal Monitoring

Sampling of lead concentrations within the breathing zone of an employee to determine the 8-hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employee's work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and the center at the nose or mouth of an employee.

1.3 QUALITY ASSURANCE

1.3.1 Medical Examinations

Before exposure to lead-contaminated dust, provide workers with a comprehensive medical examination as required by 29 CFR 1926.59. The examination will not be required if adequate records show that employees have been examined as required by 29 CFR 1926.59 within the last year.

1.3.1.1 Medical Records

Maintain complete and accurate medical records of employees for a period of at least 40 years or for the duration of employment plus 20 years, whichever is longer.

1.3.2 CIH Responsibilities

a. Certify training.

b. Review and approve materials coated with lead-contaminated paint Removal Work Plan for conformance to the applicable referenced standards.

c. Inspect lead-contaminated paint removal work for conformance with the approved plan.

d. Direct monitoring.

e. Ensure work is performed in strict accordance with specifications at all times.

f. Ensure hazardous exposure to personnel and to the environment are adequately controlled at all times.

g. Review and approve "Hazardous Waste Management Plan."

1.3.3 Training

Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment, in accordance with 29 CFR 1926.62.

1.3.3.1 Training Certification

Submit certificates signed and dated by the CIH and by each employee stating that the employee has received training.

1.3.4 Respiratory Protection Program

a. Furnish each employee required to wear a negative pressure

respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least every 6 months thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.3.5 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.3.6 Hazardous Waste Management

The Hazardous Waste Management plan shall comply with applicable requirements of federal, state, and local hazardous waste regulations and address:

a. Identification of hazardous wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes consisting of lead chips and/or dust not intact lead-coated materials. Include the facility location and a 24-hour point of contact. Furnish two copies of EPA, state hazardous waste permits and EPA Identification numbers.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures to be implemented.

g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.

h. Cost for hazardous waste disposal according to this plan.

1.3.7 Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, state, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

1.3.8 Pre-Construction Conference

Along with the CIH, meet with the Contracting Officer to discuss in detail

the materials coated with lead-contaminated paint removal work plan, including work procedures and precautions for the work plan.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-03 Product Data

Vacuum filters

Respirators

SD-06 Test Reports

Monitoring Results

SD-07 Certificates

Qualifications of CIH

Testing laboratory qualifications

Rental equipment notification

Preparation of Surfaces Coated with Lead-Contaminated Paint Work Plan with CIH approval (signature, date, and certification number)

Respiratory protection program

Hazard communication program

EPA approved hazardous waste treatment or disposal facility for lead disposal

Hazardous waste management plan

Vacuum filters

SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility

Certification of medical examinations

Employee training certification

1.4.1 Qualifications of CIH

Submit name, address, and telephone number of the CIH selected to perform responsibilities in paragraph entitled "CIH Responsibilities." Provide previous experience of the CIH. Submit proper documentation that the Industrial Hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification.

1.4.2 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the monitoring, testing, and reporting of airborne concentrations of lead. Provide proper documentation that persons performing the analysis have been judged proficient by successful participation within the last year in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program. The laboratory shall be accredited by the American Industrial Hygiene Association (AIHA). Provide AIHA documentation along with date of accreditation/reaccreditation.

1.4.3 Preparation of Surfaces Coated with Lead-Contaminated Paint Work Plan

Submit a detailed job-specific plan of the work procedures to be used in the preparation of surfaces coated with lead-contaminated paint. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination rooms, change rooms, shower facilities, and mechanical ventilation system. Include in the plan, eating, drinking, smoking and restroom procedures, interface of trades, sequencing of lead related work, collected wastewater and paint debris disposal plan, air sampling plan, respirators, protective equipment, and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air are not exceeded outside of the lead control area. Include air sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of air monitoring personnel in the air sampling portion of the plan.

1.4.4 Air Monitoring

Submit monitoring results to the Contracting Officer within 3 working days, signed by the testing laboratory employee performing the air monitoring, the employee that analyzed the sample, and the CIH.

1.5 EQUIPMENT

Furnish the Contracting Officer with two complete sets of personal protective equipment daily, as required herein, for entry into and inspection of the removal work within the lead controlled area. Personal protective equipment shall include fitted respirators and disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor.

1.5.1 Respirators

Furnish appropriate respirators approved by the NIOSH, Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.5.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with appropriate disposable protective whole body clothing, head covering, gloves, and foot coverings. Furnish appropriate disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CIH.

1.5.3 Rental Equipment Notification

If rental equipment is to be used during lead-contaminated paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

1.5.4 Vacuum Filters

UL 586 labeled HEPA filters.

PART 2 PRODUCTS

2.1 PAINT PREPARATION PRODUCTS

Submit applicable Material Safety Data Sheets for Surface Preparation products used. Ust the least toxic product.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Notification

Notify the Contracting Officer 20 days prior to the start of any surface preparation work.

3.1.2 RESERVED

3.1.3 Protection of Existing Work to Remain

Perform surface preparation work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.

3.1.4 Boundary Requirements

Provide physical boundaries around the lead control area by roping off the area or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.

3.1.5 Furnishings

The Contractor shall cover all Government furniture and equipment located in the work area before lead-contaminated paint surface preparation work begins.

3.1.6 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6-mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area.

3.1.7 Change Room and Shower Facilities

Provide clean change rooms and shower facilities within the physical boundary around the designated lead control area in accordance with

requirements of 29 CFR 1926.62.

3.1.8 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.57.

b. To the extent feasible, use local exhaust ventilation connected to HEPA filters or other collection systems, approved by the industrial hygienist. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.

3.1.9 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been given appropriate training and protective equipment.

3.1.10 Warning Signs

Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.2 WORK PROCEDURES

The work shall include removal of materials coated with lead containing paint. Remove dirt, dust, rust, caulking, splinters, loose particles, grease, oil, disintegrated coatins, mildew, mold, and othe substances deleterious to coating performance. Sand, spackle, and treat defects to render them smooth. Defects are defined as scratches, nicks, cracks, gouges, spills, alligatoring, previous runs, chalking, and irregularities due to partial peeling of previous coatings. Sand edges of adjacent soundly-ahdered existing coatings so they are tapered as smooth as practical. On interior surfaces, edges may be filled smooth with joint compound in lieu of sanding. The Contractor is advised of these conditions and shall be responsible for compliance with all EPA, Federal, State and Local Requirements.

3.2.1 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:

a. Vacuum themselves off.

b. Remove protective clothing in the decontamination room, and place them in an approved impermeable disposal bag.

c. Shower.

d. Change to clean clothes prior to leaving the physical boundary designated around the lead-contaminated job site.

3.2.2 Monitoring

Monitoring of airborne concentrations of lead shall be in accordance with 29 CFR 1926.62 and as specified herein. Air monitoring, testing, and reporting shall be performed by a CIH or an Industrial Hygiene (IH) Technician who is under the direction of the CIH.

a. The CIH or the IH Technician under the direction of the CIH shall be on the jobsite directing the monitoring, and inspecting the lead-contaminated paint removal work to ensure that the requirements of the Contract have been satisfied during the entire removal of materials coated with lead-contaminated paint operation.

b. Take personal air monitoring samples on employees who are anticipated to have the greatest risk of exposure as determined by the CIH. In addition, take air monitoring samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air monitoring samples, signed by the CIH, within 72 hours after the air samples are taken. Notify the Contracting Officer immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the lead control area.

3.2.2.1 Monitoring During Surface Preparation Work

Perform personal and area monitoring during the surface preparation operation. Sufficient area monitoring shall be conducted at the physical boundary to ensure unprotected personnel are not exposed above 30 micrograms per cubic meter of air at all times. If the outside boundary lead levels are at or exceed 30 micrograms per cubic meter of air, work shall be stopped and the CIH shall immediately correct the condition(s) causing the increased levels and notify the Contracting Officer immediately. The CIH shall review the sampling data collected on that day to determine if condition(s) requires any further change in work methods. Removal work shall resume when approval is given by the CIH. The Contractor shall control the lead level outside of the work boundary to less than 30 micrograms per cubic meter of air at all times. As a minimum, conduct area monitoring daily on each shift in which lead paint removal operations are performed in areas immediately adjacent to the lead control area. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area. If adjacent areas are contaminated, clean and visually inspect contaminated areas. The CIH shall certify that the area has been cleaned of lead contamination.

3.3 CLEANUP AND DISPOSAL

3.3.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the surface preparation operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner and wet mopping the area.

3.3.2 Certification

The CIH shall certify in writing that the inside and outside the lead control area agressive air monitoring samples are less than 30 micrograms per cubic meter of air, the respiratory protection for the employees was adequate, the work procedures were performed in accordance with 29 CFR 1926.62, and that there were no visible accumulations of lead-contaminated paint and dust on the worksite. Do not remove the lead control area or roped-off boundary and warning signs prior to the Contracting Officer's receipt of the CIH's certification. Reclean areas showing dust or residual paint chips.

3.3.3 Disposal

Dispose of removed materials and associated waste in compliance with Environmental Protection Agency (EPA), Federal, State, and Local requirements and the approved work plans for removal and disposal.

a. Materials (except metals) coated with lead-contaminated paint which is well adhered shall be disposed of in the Base Sanitary Landfill, provided all Base and Landfill requirements are complied with. Comply with the land disposal restriction notification requirements of 40 CFR 258.

3.3.4 Testing of Lead-Contaminated Paint Residue

Test lead-contaminated paint residue and debris in accordance with 40 CFR 261 for hazardous waste. A composite sample of dust and debris collected after removal is complete must be tested for lead using EPA Protocol Total Charagteristic Leachate Procedure (TCLP) Test. If the results are less than five parts per million, the debris shall be disposed in the Base Sanitary Landfill. If the results are equal to or greater than five parts per million, the debris shall be disposed in an approved hazardous waste facility.

3.4 PAYMENT FOR HAZARDOUS WASTE

Payment for disposal of hazardous waste shall not be made until a signed copy of the manifest from the disposal facility certifying the amount of hazardous waste delivered is returned and a copy is furnished to the Government.

-- End of Section --

SECTION 02 82 33.13

REMOVAL AND DISPOSAL OF MATERIALS COATED WITH LEAD-CONTAINING PAINT

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z88.2	(1992) Respiratory Protection

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.57	Ventilation
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead Exposure in Construction
29 CFR 1926.103	Respiratory Protection
40 CFR 258	Disposal of Hazardous Materials
40 CFR 261	Identification and Listing of Hazardous Waste

UNDERWRITERS LABORATORIES (UL)

UL 586	(1996; Rev thru Aug 1999) High-Efficiency, Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8-hour period. As used in this section, "30 micrograms per cubic meter of air" refers to the action level.

1.2.2 Area Monitoring

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead

concentrations which may reach the breathing zone of personnel potentially exposed to lead.

1.2.3 Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area."

1.2.4 Certified Industrial Hygienist (CIH)

As used in this section, refers to an Industrial Hygienist employed by the Contractor and is certified by the American Board of Industrial Hygiene in comprehensive practice.

1.2.5 Change Rooms and Shower Facilities

Rooms within the designated physical boundary around the lead control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevent cross-contamination.

1.2.6 Decontamination Room

Room for removal of contaminated personal protective equipment (PPE).

1.2.7 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead averaged over an 8-hour workday to which an employee is exposed.

1.2.8 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron size particles.

1.2.9 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.

1.2.10 Lead Control Area

An enclosed area or structure with full containment to prevent the spread of lead dust, paint chips, or debris of lead-containing paint removal operations. The lead control area is isolated by physical boundaries to prevent unauthorized entry of personnel.

1.2.11 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8-hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than 8 hours in a work day, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.12 Personal Monitoring

Sampling of lead concentrations within the breathing zone of an employee to determine the 8-hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employee's work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and the center at the nose or mouth of an employee.

1.3 QUALITY ASSURANCE

1.3.1 Medical Examinations

Before exposure to lead-contaminated dust, provide workers with a comprehensive medical examination as required by 29 CFR 1926.59. The examination will not be required if adequate records show that employees have been examined as required by 29 CFR 1926.59 within the last year.

1.3.1.1 Medical Records

Maintain complete and accurate medical records of employees for a period of at least 40 years or for the duration of employment plus 20 years, whichever is longer.

1.3.2 CIH Responsibilities

a. Certify training.

b. Review and approve materials coated with lead-containing paint Removal Work Plan for conformance to the applicable referenced standards.

c. Inspect lead-containing paint removal work for conformance with the approved plan.

d. Direct monitoring.

e. Ensure work is performed in strict accordance with specifications at all times.

f. Ensure hazardous exposure to personnel and to the environment are adequately controlled at all times.

1.3.3 Training

Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment, in accordance with 29 CFR 1926.62.

1.3.3.1 Training Certification

Submit certificates signed and dated by the CIH and by each employee stating that the employee has received training.

1.3.4 Respiratory Protection Program

a. Furnish each employee required to wear a negative pressure respirator or other appropriate type with a respirator fit test at the time of initial fitting and at least every 6 months thereafter

as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.3.5 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.3.6 Hazardous Waste Management

The Hazardous Waste Management plan shall comply with applicable requirements of federal, state, and local hazardous waste regulations and address:

a. Identification of hazardous wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes consisting of lead chips and/or dust not intact lead-coated materials. Include the facility location and a 24-hour point of contact. Furnish two copies of EPA, state, and local hazardous waste permit applications, permits, and EPA Identification numbers.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures to be implemented.

g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.

h. Cost for hazardous waste disposal according to this plan.

1.3.7 Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, state, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

1.3.8 Pre-Construction Conference

Along with the CIH, meet with the Contracting Officer to discuss in detail the materials coated with lead-containing paint removal work plan, including work procedures and precautions for the work plan.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 0, "Submittal Procedures

SD-03 Product Data

Vacuum filters

Respirators

SD-06 Test Reports

Monitoring Results

SD-07 Certificates

Qualifications of CIH

Testing laboratory qualifications

Materials coated with lead-containing paint removal work plan

Rental equipment notification

CIH approval of work plan (signature, date, and certification number)

Respiratory protection program

Hazard communication program

EPA approved hazardous waste treatment or disposal facility for lead disposal

Hazardous waste management plan

Vacuum filters

SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility

Certification of medical examinations

Employee training certification

1.4.1 Qualifications of CIH

Submit name, address, and telephone number of the CIH selected to perform responsibilities in paragraph entitled "CIH Responsibilities." Provide previous experience of the CIH. Submit proper documentation that the Industrial Hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification.

1.4.2 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the monitoring, testing, and reporting of airborne concentrations of lead. Provide proper documentation that persons performing the analysis have been judged proficient by successful participation within the last year in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program. The laboratory shall be accredited by the American Industrial Hygiene Association (AIHA). Provide AIHA documentation along with date of accreditation/reaccreditation.

1.4.3 Materials Coated with Lead-Containing Paint Removal Work Plan

Submit a detailed job-specific plan of the work procedures to be used in the removal of materials coated with lead-containing paint. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination rooms, change rooms, shower facilities, and mechanical ventilation system. Include in the plan, eating, drinking, smoking and restroom procedures, interface of trades, sequencing of lead related work, collected wastewater and paint debris disposal plan, air sampling plan, respirators, protective equipment, and a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air are not exceeded outside of the lead control area. Include air sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of air monitoring personnel in the air sampling portion of the plan.

1.4.4 Air Monitoring

Submit monitoring results to the Contracting Officer within 3 working days, signed by the testing laboratory employee performing the air monitoring, the employee that analyzed the sample, and the CIH.

1.5 REMOVAL

1.5.1 Title to Materials

Materials resulting from demolition work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of in accordance with Section 02 41 00, "Demolition," except as specified herein.

1.6 EQUIPMENT

Furnish the Contracting Officer with two complete sets of personal protective equipment daily, as required herein, for entry into and inspection of the removal work within the lead controlled area. Personal protective equipment shall include fitted respirators and disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor.

1.6.1 Respirators

Furnish appropriate respirators approved by the NIOSH, Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62 and 29 CFR 1926.103.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with appropriate disposable protective whole body clothing, head covering, gloves, and foot coverings. Furnish appropriate disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CIH.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during lead-containing paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Notification

Notify the Contracting Officer 20 days prior to the start of any removal work.

3.1.2 Lead Control Area Requirements

a. Establish a lead control area by completely enclosing with containment screens the area or structure where materials coated with lead-containing paint removal operations will be performed.

or

a. Contain removal operations by the use of a negative pressure full containment system with at least one change room and with HEPA filtered exhaust.

3.1.3 Protection of Existing Work to Remain

Perform removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.

3.1.4 Boundary Requirements

Provide physical boundaries around the lead control area by roping off the area or providing curtains, portable partitions or other enclosures to ensure that airborne concentrations of lead will not reach 30 micrograms per cubic meter of air outside of the lead control area.

3.1.5 Furnishings

The Government will remove furniture and equipment from the work area before lead-containing paint removal work begins.

3.1.6 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6-mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area.

3.1.7 Change Room and Shower Facilities

Provide clean change rooms and shower facilities within the physical boundary around the designated lead control area in accordance with requirements of 29 CFR 1926.62.

3.1.8 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.57.

b. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems, approved by the industrial hygienist. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.

3.1.9 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been given appropriate training and protective equipment.

3.1.10 Warning Signs

Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.2 WORK PROCEDURES

The work shall include removal of materials coated with lead containing paint. Materials shall be removed with coating adhered and intact. No sanding, sandblasting or other procedures which may cause lead containing particles to become airborne shall be used for demolition. The Contractor is advised of these conditions and shall be responsible for compliance with all EPA, Federal, State and Local Requirements.

3.2.1 Painted Cabinets, Wood Trim, Drywall, Windows, and Doors

Remove all painted cabinets, wood trim, drywall, windows, and doors with coating intact. Perform removal of materials coated with lead-containing paint in accordance with approved procedures. Use procedures and equipment required to limit occupational environmental exposure to lead when materials coated with lead-containing paint are removed in accordance with

29 CFR 1926.62, except as specified herein.

3.2.2 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:

a. Vacuum themselves off.

b. Remove protective clothing in the decontamination room, and place them in an approved impermeable disposal bag.

c. Shower.

d. Change to clean clothes prior to leaving the physical boundary designated around the lead-contaminated job site.

3.2.3 Monitoring

Monitoring of airborne concentrations of lead shall be in accordance with 29 CFR 1926.62 and as specified herein. Air monitoring, testing, and reporting shall be performed by a CIH or an Industrial Hygiene (IH) Technician who is under the direction of the CIH.

a. The CIH or the IH Technician under the direction of the CIH shall be on the jobsite directing the monitoring, and inspecting the lead-containing paint removal work to ensure that the requirements of the Contract have been satisfied during the entire removal of materials coated with lead-containing paint operation.

b. Take personal air monitoring samples on employees who are anticipated to have the greatest risk of exposure as determined by the CIH. In addition, take air monitoring samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air monitoring samples, signed by the CIH, within 72 hours after the air samples are taken. Notify the Contracting Officer immediately of exposure to lead at or in excess of the action level of 30 micrograms per cubic meter of air outside of the lead control area.

3.2.3.1 Monitoring During Removal Work

Perform personal and area monitoring during the entire removal operation. Sufficient area monitoring shall be conducted at the physical boundary to ensure unprotected personnel are not exposed above 30 micrograms per cubic meter of air at all times. If the outside boundary lead levels are at or exceed 30 micrograms per cubic meter of air, work shall be stopped and the CIH shall immediately correct the condition(s) causing the increased levels and notify the Contracting Officer immediately. The CIH shall review the sampling data collected on that day to determine if condition(s) requires any further change in work methods. Removal work shall resume when approval is given by the CIH. The Contractor shall control the lead level outside of the work boundary to less than 30 micrograms per cubic meter of air at all times. As a minimum, conduct area monitoring daily on each shift in which lead paint removal operations are performed in areas immediately adjacent to the lead control area. For outdoor operations, at

least one sample on each shift shall be taken on the downwind side of the lead control area. If adjacent areas are contaminated, clean and visually inspect contaminated areas. The CIH shall certify that the area has been cleaned of lead contamination.

3.3 MATERIALS COATED WITH LEAD-CONTAINING PAINT REMOVAL

Manual or power sanding of interior and exterior surfaces is not permitted. Remove materials coated with lead containing paint within the areas designated on the drawings. Take whatever precautions are necessary to minimize damage to the underlying substrate or adjacent surfaces to remain.

3.4 CLEANUP AND DISPOSAL

3.4.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner and wet mopping the area.

3.4.2 Certification

The CIH shall certify in writing that the inside and outside the lead control area air monitoring samples are less than 30 micrograms per cubic meter of air, the respiratory protection for the employees was adequate, the work procedures were performed in accordance with 29 CFR 1926.62, and that there were no visible accumulations of lead-contaminated paint and dust on the worksite. Do not remove the lead control area or roped-off boundary and warning signs prior to the Contracting Officer's receipt of the CIH's certification. Reclean areas showing dust or residual paint chips.

3.4.3 Testing of Lead-Containing Paint Residue

Test lead containing paint residue in accordance with 40 CFR 261 for hazardous waste. A composite sample of dust and debris collected after removal is complete must be tested for lead using EPA protocol Total Characteristic Leachate Procedure (TCLP) Test. If the results of that test are less than five parts per million (PPM), it may be disposed of at the Base Landfill. If the results are greater than five PPM, it will be considered a hazardous waste and disposed of accordingly.

3.4.4 Disposal

Dispose of removed materials and associated waste in compliance with Environmental Protection Agency (EPA), Federal, State, and Local requirements and the approved work plans for removal and disposal.

a. Materials (except metals) coated with lead-containing paint which is well adhered shall be disposed of in the Base Sanitary Landfill, provided all Base and Landfill requirements are complied with. Comply with the land disposal restriction notification requirements of 40 CFR 258.

b. All debris, paint chips, and dust may be considered a hazardous waste. Dispose of this material (if TCLP = 5ppm) off Base in an approved hazardous waste facility.

-- End of Section --

SECTION 03 01 30.71

CONCRETE REHABILITATION
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 31/C 31M	(2006) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2005e1) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

1.2 DEFINITIONS

1.2.1 Epoxy Resin Binder

A two-component epoxy bonding system in low and medium viscosities used by itself as a primer or for producing epoxy concrete or mortars when mixed with aggregate.

1.2.2 Epoxy Concrete

A combination of epoxy resin binder and fine and coarse aggregate used in the repair of spalling along joints or cracks, small surface spalls or "popouts."

1.2.3 Epoxy Mortar

A combination of epoxy resin binder and fine aggregate used in the surface repair of non-structural cracks and filling of saw kerfs.

1.2.4 Non-Pressure Epoxy Grout

A combination of epoxy resin binder, a mineral filler and a thixotropic agent used in cementing dowels in place and the repair of non-structural cracks.

1.2.5 Pressure Grouting Epoxy

A low viscosity epoxy resin system pumped under pressure into structural cracks in walls or pavements.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05 Design Data

Job mix formula

SD-06 Test Reports

Sieve analysis test for aggregate

Epoxy resin binder tests

Epoxy grout tests

SD-07 Certificates

Epoxy resin binder

Epoxy grout

SD-08 Manufacturer's Instructions

Epoxy repair material

Submit for mixing and applying.

1.4 QUALITY ASSURANCE

1.4.1 Design Data

1.4.1.1 Job Mix Formula

Submit, at least 15 days before work commences, a job-mix formula for each use of epoxy concrete, epoxy mortar. Test reports shall accompany the mix design. Identify the proposed source of the materials and state the proportions of aggregates and epoxy resin. When determining job mix, use samples of materials to be used on the job.

a. Trial batches: Perform a minimum of three trial batchings in a certified testing laboratory. Try different aggregate-resin proportions to obtain satisfactory placing and finishing characteristics but keep the proportion by weight of aggregate to epoxy resin binder at least five to one. When mixing, add the fine aggregates first, and then the coarse aggregates. The final

trial batch should be sufficiently wet so that some fines will "bleed" to the surface during finishing operations.

b. Supporting criteria: Include in the submittal the following data for each trial batch:

(1) Proportions by weight

(2) Unit weights and specific gravities of constituents
(3) Batch weights

(4) Compressive strengths of 3 by 6 inch cylinders, made in accordance with ASTM C 31/C 31M, air cured for 7 days and tested in accordance with ASTM C 39/C 39M. Compressive strength shall be a minimum of _____ psi.

(5) Curing time

1.4.2 Test Reports

1.4.2.1 Epoxy Resin Binder

Include the following:

a. Viscosity

b. Consistency

c. Gel time

d. Absorption

e. Shrinkage

f. Thermal compatibility

1.4.2.2 Epoxy Resin Grout

Include the following:

a. Epoxy number

b. Consistency

c. Compressive single shear strength

d. Pot life

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to site for damage, unload and store with a minimum of handling. Deliver epoxy resin components and aggregate materials in original sealed containers and store in dry covered areas at temperatures below 90 degrees F. Remove from job site unused mixed materials which have reached end of working or pot life.

1.6 WEATHER LIMITATIONS

Halt work when weather conditions detrimentally affect the quality of

patching or bonding concrete. Apply epoxy resin materials only when the contact surfaces are completely dry and if the atmospheric and surface temperature ranges are suitable for the specified epoxy material. Follow manufacturer's instructions for weather conditions and temperature ranges.

1.7 TRAFFIC CONTROL

Do not permit vehicular or heavy equipment traffic on the pavement in the work area during the curing period. At the end of the curing period, light local traffic may be permitted on the pavement if approved by the Contracting Officer.

1.8 EQUIPMENT

Use a container recommended by the epoxy manufacturer as the mixing vessel. Use a power drive (air or spark-proof) propeller type blade for mixing except that hand mixing may be used for small batches. Use equipment specified by epoxy manufacturer for field mixing of aggregates and epoxy resin.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Epoxy

2.1.1.1 Epoxy Resin Binder for Concrete and Mortar

ASTM C 881/C 881M, Type III, Grade 1, 2, Class B, C without mineral filler. For walls and ceilings use ASTM C 881/C 881M, Type III, Grade 3, Class B, C with filler.

2.1.1.2 Non-Pressure Epoxy Grout

ASTM C 881/C 881M Type IV, Grade 2, 3, Class B, C with or without mineral filler.

2.1.1.3 Crack Sealer for Pressure Grouting

ASTM C 881/C 881M, Type IV, Grade 1, Class B, C without filler.

2.1.1.4 Crack Surface Sealer for Pressure Grouting

ASTM C 881/C 881M, Type IV, Grade 3, Class B, C with mineral filler.

2.1.2 Aggregate

For material passing No. 200 sieve provide a non-plastic material composed of a minimum of 75 percent limestone dust, talc or silica inert filler. Provide dry aggregate.

a. For epoxy concrete: ASTM C 33, maximum size 1/2 inch. Conform to the following requirements:

Sieve Designation	Percent Passing by Weight
1/2 in.	
3/8 in.	100
No. 4	93-100

Sieve Designation	Percent Passing by Weight
No. 8	70-80
No. 16	50-65
No. 30	37-53
No. 50	20-37
No. 100	10-20
No. 200	5-10
	3-5

b. For epoxy mortar: ASTM C 144, maximum size _____ inch. No. 8 sieve, No. 40 sieve.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Epoxy Concrete

3.1.1.1 Patch Areas

Remove loose concrete from the spalled areas indicated. Inspect the cavity for remaining defective concrete by tapping with a hammer or steel rod and listening for dull or hollow sounds. In areas where tapping does not produce a solid tone, remove additional concrete until testing produces a solid tone. Make the entire cavity at least one inch deep. Sawcut edges of cavity to avoid feather edging. Prepare surface of cavity by sandblasting, grinding, or water blasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure cavity surfaces are dry.

3.1.1.2 Spalls at Joints and Cracks

For spalls to be repaired that are adjacent to joints and working cracks insert preformed joint filler to the working faces of the spall. Trim filler to fit shape of the working faces of joint or crack so epoxy material is prevented from bypassing filler. Where practicable, extend filler horizontally and vertically into joint or crack opening. Secure filler strip in place prior to and during placement of epoxy concrete. Apply a bond breaker to working faces at keyed joints. Keep bond breaker off of concrete surface to be bonded. After the epoxy concrete has completely cured, saw out the top inch of the preformed joint filler and install liquid joint sealer in accordance with Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS, 32 13 73 COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS.

3.1.1.3 Joints and Cracks

Clean and seal joints and cracks as specified.

3.1.2 Epoxy Mortar for Cracks and Saw Kerfs

Apply epoxy mortar to newly exposed loose and unsound materials. Prepare surfaces by sandblasting, scarifying or waterblasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure surfaces are dry before application of epoxy mortar.

3.1.3 Epoxy Grout for Cracks

Apply grout to newly exposed concrete free of loose and unsound materials.

Prepare surfaces by sandblasting, scarifying or waterblasting. Remove dust, dirt, and loosely bonded material resulting from cleaning. Ensure surfaces are dry before application of epoxy grout.

3.2 MIXING MATERIALS

Make batches small enough to ensure placement before binder sets. Mix materials in accordance with manufacturer's recommendations.

3.3 PLACEMENT

3.3.1 Epoxy Concrete

Prime dry cavity surfaces with epoxy resin using a stiff bristle brush. Make coating approximately 20 mils thick. Place epoxy concrete while primer is still tacky and in layers not exceeding one inch thick. Use vibratory floats, plates, or hand tampers to consolidate the concrete. Level each layer and screed the final surface to match the adjoining surfaces. Remove excess epoxy concrete on adjacent surfaces before the concrete hardens. Do not feather epoxy concrete out onto adjacent surfaces.

3.3.2 Epoxy Mortar

Prime surfaces with epoxy resin binder. Scrub prime coat into surface with a stiff bristle brush. Make coating approximately 20 mils thick. Place epoxy mortar while primer is still tacky. Apply at a thickness recommended by the manufacturer. Work mortar into place and consolidate thoroughly so that contact surfaces are wetted by the mortar. Finish surface of mortar to the required texture. Do not feather edge epoxy mortar onto adjacent surfaces.

3.3.3 Non-Pressure Epoxy Grout

3.3.3.1 Cementing Dowels

Immediately prior to placing the dowel, clean hole of dust and other deleterious material with a high pressure air hose. Fill hole halfway with grout. Insert dowel in hole by rotating it at least one complete turn while tapping it down. If necessary add more grout to fill hole.

3.3.3.2 Epoxy Grout for Cracks

Apply epoxy grout at a thickness recommended by the manufacturer. Work grout into place and consolidate thoroughly so that contact surfaces are wetted by the grout. Finish surface of grout to the required texture. Do not feather edge epoxy grout onto adjacent surfaces.

3.3.4 Pressure Grouting of Cracks

Clean each crack of dust, dirt, loose concrete and unsound material. Insert a valve at both ends of each crack, at the junction of two cracks, and along the length of each crack at 16 to 20 inch intervals. Fill crack between valves with crack surface sealer. After crack surface sealer has hardened and cured, pump crack sealer into valve at one end of crack. For vertical surfaces start at lowest valve and work upwards. As crack sealer appears at next valve, pinch closed pumping valve and move to next valve and commence pumping. Continue procedure until other end of crack is reached. Avoid delays in pumping operation. After crack sealer has hardened and cured grind valves off flush with concrete surface. Coat

areas of valves with crack surface sealer and allow to harden and cure.

3.4 CURING

Cure epoxy materials in accordance with manufacturer's recommendations.

3.5 FIELD QUALITY CONTROL

3.5.1 Sampling

As soon as epoxy resin and aggregate materials are available for sampling, obtain by random selection a sample of each batch. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use and quantity involved.

3.5.2 Testing

At the discretion of the Contracting Officer, samples provided may be tested by the Government for verification. Test samples by an approved laboratory. If a sample fails to meet specification requirements after two tests, replace the batch represented by the samples tested and retest. Test aggregates in accordance with ASTM C 117 and ASTM C 136.

3.5.3 Inspection

Check each repaired area for cracks, spalls, popouts and loss of bond between repaired area and surrounding concrete. Check each repaired area for voids by tapping with a hammer or steel rod and listening for dull or hollow sounds. Immediately repair defects.

-- End of Section --

SECTION 03 11 14.00 10

FORMWORK FOR CONCRETE

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 347	(2004) Guide to Formwork for Concrete

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA PS 1	(1995) Voluntary Product Standard for Construction and Industrial Plywood

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1074	(2004) Standard Practice for Estimating Concrete Strength by the Maturity Method
ASTM C 1077	(2007) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 31/C 31M	(2006) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 39/C 39M	(2005e1) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

1.2 DESIGN REQUIREMENTS

The design, engineering, and construction of the formwork shall be the responsibility of the Contractor. The formwork shall be designed for anticipated live and dead loads and shall comply with the tolerances specified in Section 03 31 01.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 70 00 MASS CONCRETE, 03 30 04 CONCRETE FOR MINOR STRUCTURES, paragraph CONSTRUCTION TOLERANCES. However, for surfaces with an ACI Class A surface designation, the allowable deflection for facing material between studs, for studs between walers and walers between bracing shall be limited to 0.0025 times the span. The formwork shall be designed as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others. The adequacy of formwork design and construction shall be monitored prior to and during concrete placement as part of the Contractor's approved Quality Control Plan.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings

Drawings and design computations for all formwork required shall be submitted at least _____ days either before fabrication on site or before delivery of prefabricated forms. If reshoring is permitted, the method, including location, order, and time of erection and removal shall also be submitted for review.

SD-03 Product Data

Materials

Manufacturer's literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, and form coating, and form-lining materials.

SD-04 Samples

Sample Panels

After shop drawings have been reviewed, sample panels for Class A finish with applied architectural treatment shall be built on the project site where directed.

SD-06 Test Reports

Inspection

The Contractor shall submit field inspection reports for concrete forms and embedded items.

Formwork Not Supporting Weight of Concrete.

If forms are to be removed in less than 24 hours on formwork not supporting the weight of concrete, the evaluation and results of the control cylinder tests or maturity instrumentation shall be submitted to and approved before the forms are removed.

1.4 SHOP DRAWINGS

The shop drawings and data submitted shall include the type, size, quantity, and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.

1.5 SAMPLE PANELS

Panels shall be of sufficient size to contain joints and shall be not less than 6 feet long and 4 feet wide. The panels shall be of typical wall thickness and constructed containing the full allocation of reinforcing steel that will be used in the structure, with the forming system that duplicates in every detail the one that will be used in construction of the

structure. The same concrete mixture proportion and materials, the same placement techniques and equipment, and the same finishing techniques and timing shall be used that are planned for the structure. Construction of Class A finish will not be permitted until sample panels have been approved. Sample panels shall be protected from construction operations in a manner to protect approved finish, and are not to be removed until all Class A finish concrete has been accepted.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Forms and Form Liners

Forms and form liners shall be fabricated with facing materials that will produce a finish meeting the specified irregularities in formed surface requirements as defined in ACI 347. Forms and form liners shall be fabricated with facing materials as specified below.

2.1.1.1 Class "A" Finish

This class of finish shall apply to _____. The form facing material shall be composed of new, well-matched tongue-and-groove lumber or new plywood panels conforming to APA PS 1, Grade B-B concrete form, Class I. High density overlay shall be used in _____locations. Structural I shall be used in _____ locations.

2.1.1.2 Class "B" Finish

This class of finish shall apply to all surfaces except those specified to receive Class A, Class C, Class D. The form facing material shall be composed of tongue-and-groove or shiplap lumber, plywood conforming to APA PS 1, Grade B-B concrete form, tempered concrete form hard board or steel. Steel lining on wood sheathing will not be permitted.

2.1.1.3 Class "C" Finish

This class of finish shall apply to _____. The form facing may be either tongue-and-groove lumber, plywood, concrete form hard board or steel. Wood form facing for curved or warped surfaces shall be composed of splines of lumber which can be bent to the required shape without splitting or cracking.

2.1.1.4 Class "D" Finish

This class of finish shall apply to _____. The form facing may be of wood or steel.

2.1.2 Form Coating

Form coating shall be commercial formulation that will not bond with, stain, cause deterioration, or any other damage to concrete surfaces. The coating shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. If special form liners are to be used, the Contractor shall follow the recommendation of the form coating manufacturer.

2.2 ACCESSORIES

Ties and other similar form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type. After the ends or end fasteners have been removed, the embedded portion of metal ties shall terminate not less than 2 inches from any concrete surface either exposed to view or exposed to water. Removable tie rods shall not be allowed in _____ locations. Plastic snap ties may be used in locations where the surface will not be exposed to view. Form ties shall be constructed so that the ends or end fasteners can be removed without spalling the concrete.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Form Construction

Forms shall be constructed true to the structural design and required alignment. The form surface and joints shall be mortar tight and supported to achieve safe performance during construction, concrete placement, and form removal. The Contractor shall continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface class or classes specified in paragraph FORMS AND FORM LINERS and tolerances specified in paragraph DESIGN REQUIREMENTS. Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse.

3.1.2 Chamfering

All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rockfill is placed in contact with concrete surfaces. Chamfered joints shall be terminated twelve inches outside the limit of the earth or rockfill so that the end of the chamfers will be clearly visible.

3.1.3 Coating

Forms for exposed or painted surfaces shall be coated with form oil or a form-release agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete, except that, in cold weather when freezing temperatures are anticipated, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.2 FORM REMOVAL

Forms shall not be removed without approval. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. In any case forms shall not be removed unless the minimum time, or minimum compressive strength, or minimum time, minimum ambient temperature, and minimum compressive strength requirements below are met, except as otherwise directed or specifically authorized. When conditions are such as to justify the requirement, forms will be required to remain in place for a longer period. All removal shall be accomplished in a manner which will prevent damage to the concrete and ensure the complete safety of the structure. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements. Form removal shall be scheduled so that all necessary repairs can be performed as specified. Evidence that concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders. All control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given those portions of the structure they represent. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be prepared and tested in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M at the expense of the Contractor by an independent laboratory that complies with ASTM C 1077 and shall be tested within 4 hours after removal from the site. After obtaining approval, the Contractor may use maturity instrumentation instead of control cylinders to determine the compressive strength of the concrete. ASTM C 1074 procedures shall be used for estimating concrete strength by means of the maturity method. All expenses associated with instrumenting the concrete and evaluating the strength using maturity relationships shall be the responsibility of the Contractor

3.2.1 Formwork Not Supporting Weight of Concrete

Formwork for walls, columns, sides of beams, gravity structures, and other vertical type formwork not supporting the weight of concrete shall not be removed in less than 24 hours after concrete placement is completed. Form removal before 24 hours will be allowed for simple floor slab, sidewalks, and driveways provided the ambient temperature during this period has not fallen below 50 degrees F at any time since placement and evidence from compressive tests on field-cured concrete control cylinders or maturity instrumentation indicates that the concrete has attained a compressive strength of at least _____ psi. Control cylinders shall be prepared for each set of forms to be removed before 24 hours. The stability of the concrete shall be evaluated by a structural engineer prior to removal of the forms.

3.2.2 Formwork Supporting Weight of Concrete

Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired sufficient strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected. As a minimum, forms shall be left in place until control concrete test cylinders or maturity

instrumentation indicate evidence the concrete has attained at least _____ percent of the compressive strength required for the structure in accordance with the quality and location requirements of Section _____ _____.

3.2.3 Tunnel Forms

Tunnel lining bulkhead forms shall not be removed in less than 12 hours and tunnel lining forms in not less than 16 hours.

3.3 INSPECTION

Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

-- End of Section --

SECTION 03 15 13.00 10

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 111	(1983; R 2004) Inorganic Matter or Ash in Bituminous Materials

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(2004) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1011/A 1011M	(2007) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 109/A 109M	(2003) Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1751	(2004) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 2628	(1991; R 2005) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 2007) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

ASTM D 4	(1986; R 2004) Bitumen Content
ASTM D 471	(1998e1) Rubber Property - Effect of Liquids
ASTM D 5249	(1995; R 2006) Backer Material for Use with Cold-and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D 6	(1995; R 2006) Loss on Heating of Oil and Asphaltic Compounds

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Specifications for Polyvinylchloride Waterstops

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Waterstops

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

SD-03 Product Data

Preformed Expansion Joint Filler
Sealant
Waterstops

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops. Manufacturer's recommended instructions for installing preformed fillers, field-molded sealants; preformed compression seals; and waterstops; and for splicing non-metallic waterstops.

SD-04 Samples

Lubricant for Preformed Compression Seals

Specimens identified to indicate the manufacturer, type of material, size and quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 9 ft of 1 inch nominal width or wider seal or a piece not less than 12 ft of compression seal less than 1 inch nominal width. One quart of lubricant shall be provided.

Non-metallic Materials

Specimens identified to indicate manufacturer, type of material, size, quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 12 inch long cut from each 200 ft of finished waterstop furnished, but not less than a total of 4 ft of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site. The splice samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 12 inches long.

SD-07 Certificates

Preformed Expansion Joint Filler
Sealant
Waterstops

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 1/8 inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8 inch thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.3 SEALANT

Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Type

ASTM D 2628.

2.3.2 Lubricant for Preformed Compression Seals

ASTM D 2835.

2.3.3 Field-Molded Type

ASTM C 920, Type M, Grade P or NS, Class 25, Use T, NT for horizontal joints. Type M, Grade NS, Class 25, Use NT for vertical joints. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

2.3.4 Hot-Applied Jet-Fuel Resistant Type

ASTM C 920, Type M, Grade P or NS, Class 25, use (T)(NT) for horizontal joints. Type M, Grade NS, Class 25, use (NT)(M)(G)(A) for vertical joints.

2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

2.4.1 Rigid Metal

Flat steel waterstops shall conform to ASTM A 109/A 109M, No. 2 (half hard) temper, No. 2 edge, No. 1 (matte or dull) finish or ASTM A 1011/A 1011M, Grade 40.

2.4.2 Non-Metallic Materials`

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops shall conform to ASTM D 471.

2.4.3 Preformed Elastic Adhesive

Preformed plastic adhesive waterstops shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, asbestos, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength.

2.4.3.1 Chemical Composition

The chemical composition of the sealing compound shall meet the requirements shown below:

PERCENT BY WEIGHT

COMPONENT	MIN.	MAX.	TEST
Bitumen (Hydrocarbon plastic)	50	70	ASTM D 4
Inert Mineral Filler	30	50	AASHTO T 111
Volatile Matter		2	ASTM D 6

2.4.3.2 Adhesion Under Hydrostatic Pressure

The sealing compound shall not leak at the joints for a period of 24 hours under a vertical 6 foot head pressure. In a separate test, the sealing compound shall not leak under a horizontal pressure of 10 psi which is

reached by slowly applying increments of 2 psi every minute.

2.4.3.3 Sag of Flow Resistance

Sagging shall not be detected when tested as follows: Fill a wooden form 1 inch wide and 6 inches long flush with sealing compound and place in an oven at 135 degrees F in a vertical position for 5 days.

2.4.3.4 Chemical Resistance

The sealing compound when immersed separately in a 5% solution of caustic potash, a 5% solution of hydrochloric acid, 5% solution of sulfuric acid and a saturated hydrogen sulfide solution for 30 days at ambient room temperature shall show no visible deterioration.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 1 inch.

3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained during insertion.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly

finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.1.3.1 Joints With Preformed Compression Seals

Compression seals shall be installed with equipment capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal or concrete and with no more than 5 percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant. Butt joints shall be coated with liberal applications of lubricant.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

3.2.1 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.

3.2.1.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

3.2.1.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.1.3 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than 1/16 inch. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 1/16 inch or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2 inch in 10 feet. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.2.2 Non-Metallic Hydrophilic Waterstop Installation

Ends to be joined shall be miter cut with sharp knife or shears. The ends shall be adhered with cyanacryiate (super glue) adhesive. When joining hydrophilic type waterstop to PVC waterstop, the hydrophilic waterstop shall be positioned as shown on the drawings. A liberal amount of a single component hydrophilic sealant shall be applied to the junction to complete the transition.

3.2.3 Preformed Plastic Adhesive Installation

The installation of preformed plastic adhesive waterstops shall be a prime, peel, place and pour procedure. Joint surfaces shall be clean and dry before priming and just prior to placing the sealing strips. The end of each strip shall be spliced to the next strip with a 1 inch overlap; the overlap shall be pressed firmly to release trapped air. During damp or cold conditions the joint surface shall be flashed with a safe, direct flame to warm and dry the surface adequately; the sealing strips shall be dipped in warm water to soften the material to achieve maximum bond to the concrete surface.

3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

-- End of Section --

SECTION 03 20 01.00 10

CONCRETE REINFORCEMENT

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318/318R	(2005; Errata 2005) Building Code Requirements for Structural Concrete and Commentary

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 184/A 184M	(2006) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 496/A 496M	(2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497/A 497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 615/A 615M	(2007) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(2003e1) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(2006a) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 767/A 767M	(2005) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775/A 775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 884/A 884M	(2006) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM C 1116/C 1116M	(2006) Standard Specification for Fiber-Reinforced Concrete

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2001; 27Ed) Manual of Standard Practice

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-03 Product Data

Welding

A list of qualified welders names.

SD-07 Certificates

Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4/D1.4M. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4/D1.4M.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53/A 53M, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82/A 82M. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185/A 185M, ASTM A 496/A 496M, ASTM A 497/A 497M. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 10MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

2.7 SYNTHETIC FIBER REINFORCEMENT

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inches.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4/D1.4M. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at

right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.4 SYNTHETIC FIBER REINFORCED CONCRETE

Fiber reinforcement shall be added to the concrete mix in accordance with the applicable sections of ASTM C 1116/C 1116M and the recommendations of the manufacturer, and in an amount of 0.1 percent by volume.

3.5 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS and Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI/MCP-1	(2007) Manual of Concrete Practice Part 1: ACI 104-71R-97 to 223-98
ACI/MCP-2	(2007) Manual of Concrete Practice Part 2 - ACI 224R-01 to ACI 313R-97
ACI/MCP-3	(2007) Manual of Concrete Practice Part 3 - ACI 315-99 to ACI 343R-95
ACI/MCP-4	(2006) Manual of Concrete Practice Part 4 - ACI 345R-05 to 355.2R-04

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
AASHTO M 53	(1996) Standard Specification Axle-Steel Deformed and Plain Bars for Concrete Reinforcement

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(2004) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A 496/A 496M	(2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497/A 497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 615/A 615M	(2007) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(2006a) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(2005) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775/A 775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 934/A 934M	(2007) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A 996/A 996M	(2006a) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars or Concrete Reinforcement
ASTM C 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107/C 1107M	(2007a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116/C 1116M	(2006) Standard Specification for Fiber-Reinforced Concrete
ASTM C 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 143/C 143M	(2005a) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 156	(2005) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 1567	(2007) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2007) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2007) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2004) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 233	(2007) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 295	(2003) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2006) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 311	(2005) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 330	(2005) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2005e1) Standard Test Method for Compressive Strength of Cylindrical

	Concrete Specimens
ASTM C 42/C 42M	(2004) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2005a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 567	(2005a) Determining Density of Structural Lightweight Concrete
ASTM C 595	(2007) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2005) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM C 932	(2006) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2007) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2006) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 990	(2006) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	(2004) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

ASTM D 2103	(2005) Standard Specification for Polyethylene Film and Sheeting
ASTM D 2628	(1991; R 2005) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 4397	(2002) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 5759	(1995; R 2005) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D 7116	(2005) Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types, for Portland Cement Concrete
ASTM E 1155	(1996; R 2001) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E 329	(2007a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 648	(2006a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2001; 27Ed) Manual of Standard Practice

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2007) Construction and Industrial Plywood

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 572	(1974) Specifications for Polyvinylchloride Waterstops

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1	(1995) Construction and Industrial Plywood (APA V995)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS LLL-B-810	(Rev B) Building Board, (Hardboard) Hard Pressed, Vegetable Fiber
FS MMM-A-001993	(1978) Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting)

FS SS-S-1614	(Rev A; Am 1) Sealants, Joint,Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements
FS SS-S-200	(Rev E; Am 2) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement
FS UU-B-790	(Rev A) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and silica fume.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings for concrete formwork must be submitted by the Contractor in accordance with paragraph entitled, "Shop Drawings," of this section, to include the following:

Formwork
Column Forms
Wall Forms
Floor Forms
Ceiling Forms
Special Construction

Reinforcing steel

Reproductions of contract drawings are unacceptable.

Provide erection drawings for concrete Formwork that show placement of reinforcement and accessories, with reference to the contract drawings.

SD-03 Product Data

Materials for curing concrete
Joint sealants; (LEED)

Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the following items must include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops, and liquid chemical floor hardeners.

Joint filler; (LEED)
Plastic Forms
Carton Forms
Recycled Aggregate Materials; (LEED)
Cement; (LEED)
Portland Cement
Ready-Mix Concrete
Water-Vapor Barrier Subgrade Cover
Bonding Materials
Floor Finish Materials
Concrete Curing Materials
Reinforcement; (LEED)
Reinforcement Materials
Liquid Chemical Floor Hardener

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Vapor retarder, Vapor barrier

Epoxy bonding compound

Synthetic reinforcing fibers

Waterstops

Wood Forms

Local/Regional Materials; (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Biodegradable Form Release Agent

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

SD-04 Samples

Dumbbell Type
Rubber
Polyvinylchloride (PVC)

SD-05 Design Data

Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, silica fume, ground slag, polypropylene fibers, and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of the fly ash, silica fume, polypropylene fibers and pozzolan test results, in addition. The approval of fly ash, silica fume, and pozzolan, and polypropylene fibers test results must be within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

Calculations

SD-06 Test Reports

Concrete mix design

Fly ash

Pozzolan

Ground granulated blast-furnace slag

Aggregates

Fiber-reinforced concrete

Tolerance report

Compressive strength tests

Unit weight of structural lightweight concrete

Ion concentration

Air Content

Slump

Air Entrainment

SD-07 Certificates

Curing concrete elements

Pumping concrete

Silica fume manufacturer's representative

Finishing plan

Form removal schedule

Biodegradable Form Release Agent

VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Material Safety Data Sheets

Forest Stewardship Council (FSC) Certification

SD-08 Manufacturer's Instructions

Fly ash

Ground granulated blast-furnace slag

SD-11 Closeout Submittals

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI/MCP-2 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or

racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.5.1.1 Epoxy Coated Reinforcing Steel

Record coating lot on each shipping notice and carefully identify and re-tag bar bundles from bending plant. Provide systems for handling coated bars which have padded contact areas, nylon slings, etc., all free of dirt and grit. Lift bundled coated bars with strong back, multiple supports, or platform bridge to prevent sagging and abrasion. Pad bundling bands where in contact with bars. Do not drop or drag bars or bundles. Store coated bars both in shop and in field, aboveground, on wooden or padded cribbing. Space the dunnage close enough to prevent excessive sags. Stack large quantities of straight bars with adequate protective blocking between layers. Schedule deliveries of epoxy coated bars to the job site to avoid the need for long term storage. Protect from direct sunlight and weather. Cover bars to be stored longer than 12 hours at the job site with opaque polyethylene sheeting or other suitable equivalent protective material.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Formwork Calculations

ACI/MCP-4. Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Furnish drawings and calculations of shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members.

1.6.2 Drawings

1.6.2.1 Shop Drawings

Fabrication Drawings for concrete formwork for Reinforcement Materials, Column Forms, Wall Forms, Floor Forms, Ceiling Forms and for Special Construction must indicate concrete pressure calculations with both live and dead loads, along with material types. Provide all design calculations in accordance with ACI/MCP-2 and ACI/MCP-3.

1.6.2.2 Formwork

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Reproductions of contract drawings are unacceptable.

Design, fabricate, erect, support, brace, and maintain formwork so that it is capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

1.6.2.3 Reinforcing Steel

ACI/MCP-4. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.6.3 Control Submittals

1.6.3.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.6.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

1.6.3.3 Silica Fume Manufacturer's Representative

Provide statement that the manufacturer's representative must be present at mix plant to ensure proper mix, including high range water reducer, and batching methods during the first 3 days of concrete mix preparation and placement. After which the manufacturer's representative must designate a representative at the concrete producer's plant to ensure the concrete mix procedures meet the silica fume manufacturer's recommendations. Representative to attend and advise at finishing of sample slab.

1.6.3.4 Finishing Plan

Submit proposed material and procedures to be used in obtaining the finish for the floors. Include qualification of person to be used for obtaining floor tolerance measurement, description of measuring equipment to be used, and a sketch showing lines and locations the measuring equipment will follow.

1.6.3.5 Form Removal Schedule

Submit schedule for form removal indicating element and minimum length of time for form removal.

1.6.3.6 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.6.3.7 Material Safety Data Sheets

Submit Material Safety Data Sheets (MSDS) for all materials that are regulated for hazardous health effects. Prominently post the MSDS at the construction site.

1.6.4 Test Reports

1.6.4.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. Include mill test and all other test for cement, silica fume, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Submit test reports along with the concrete mix design. Obtain approval before concrete placement.

1.6.4.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C 618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on fly ash use in concrete.

1.6.4.3 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C 989 for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on slag use in concrete.

1.6.4.4 Aggregates

ASTM C 1260 for potential alkali-silica reactions, ASTM C 295 for petrographic analysis.

1.6.4.5 Fiber-Reinforced Concrete

Test to determine flexural toughness index I5 in accordance with ASTM C 1116/C 1116M.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing compound/sealer curing period or for 72 hours after installation:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

a. Provide data indication the percentage of post-industrial pozzolan (fly ash, blast furnace slag) cement substitution as a percentage of the full product composite by weight.

b. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.

c. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.

d. Provide product data stating the location where all products were manufactured

e. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products.

f. For projects using reusable formwork, provide data showing how formwork is reused.

g. Provide MSDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.

h. Provide MSDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Concrete materials may be locally available.

1.9 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM E 329.

1.10 QUALIFICATIONS FOR WELDING WORK

Section 05 05 23 WELDING, STRUCTURAL applies to work specified in this section.

Welding procedures must be in accordance with AWS D1.4/D1.4M.

Verify that Welder qualifications are in accordance with AWS D1.4/D1.4M or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

1.11 CONCRETE SAMPLING AND TESTING

Testing by the Contractor must include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete. Perform quality control testing during construction.

Sample and test concrete aggregate materials proposed for use in the work in accordance with ASTM C 33.

Sample and test portland cement in accordance with ASTM C 150.

Sample and test air-entraining admixtures in accordance with ASTM C 233.

Testing must be performed by a Grade I Testing Technician.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel

forms where a smooth form finish is required.

2.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Submit data verifying that composite wood products contain no urea formaldehyde resins. Virgin wood used must be FSC-certified.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Plastic Forms

Plastic lumber as specified in Section 06 10 00 ROUGH CARPENTRY. Provide plastic forms that contain a minimum of 50, 100 percent post-consumer recycled content, or a minimum of 50, 100 percent post-industrial recycled content.

2.1.3 Carton Forms

Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set. Provide carton forms that contain a minimum of 5, 10 percent post-consumer recycled content, or a minimum of 20, 40 percent post-industrial recycled content.

2.1.4 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Provide form ties and accessories that do not reduce the effective cover of the reinforcement.

2.2.1 Polyvinylchloride Waterstops

COE CRD-C 572.

2.2.2 Dovetail Anchor Slot

Preformed metal slot approximately 1 by 1 inch of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material.

2.3 CONCRETE

2.3.1 Contractor's Option for Material Only

At the option of the Contractor, those applicable material sections of DOT RBS for Class A strength concrete must govern in lieu of this specification for concrete. Do not change the selected option during the course of the work.

2.3.2 Contractor-Furnished Mix Design

ACI/MCP-1, ACI/MCP-2, and ACI/MCP-3 and ACI/MCP-1, ACI/MCP-2 and ACI/MCP-1 except as otherwise specified. Indicate the compressive strength (f'c) of the concrete for each portion of the structure(s) and as specified.

Maximum slump shown above may be increased 1 inch for methods of consolidation other than vibration. Slump may be increased to 8 inches when superplasticizers are used. Provide air entrainment using air-entraining admixture. Provide air entrainment within plus or minus 1.5 percent of the value specified. The water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days must not exceed 0.15, 1.00, 0.30. Note (a): Entrapped air must be 3% or less.

Proportion concrete mixes for strength at 56, 90 days.

2.3.2.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI/MCP-1. In the trial mixture, use at least three different water-cement ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required must be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast-furnace slag by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cement ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M for 7 and 28 days. From these results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

2.3.2.2 Lightweight Concrete Proportion

ACI/MCP-1, using weight method. Provide ASTM C 330 aggregates for

concrete; 115 pcf (dry) for floors with a ____ psi minimum compressive strength at 28 days. Provide aggregate size No. _____. Range of slump must be between _____ and _____ inches. Provide _____ percent air entrainment using an air-entraining admixture. Maximum water-cement ratio must be _____.

2.3.2.3 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI/MCP-2. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI/MCP-2. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength must follow ACI/MCP-2 requirements.

2.3.3 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C 94/C 94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C 94/C 94M:

Type and brand cement

Cement content in 95-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water/cement ratio

2.3.4 Concrete Curing Materials

2.3.4.1 Absorptive Cover

Provide burlap cloth cover for curing concrete made from jute or kenaf, weighing 10 ounces plus or minus 5 percent per square yard when clean and dry, conforming to ASTM C 171, Class 3; or cover may be cotton mats as approved.

2.3.4.2 Moisture-Retaining Cover

Provide waterproof paper cover for curing concrete conforming to ASTM C 171, regular or white, or polyethylene sheeting conforming to ASTM C 171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap must conform to ASTM C 171, Class 3, and polyethylene film must conform to ASTM C 171. When tested for water retention in accordance with ASTM C 156, weight of water lost 72 hours after application of moisture retaining covering material must not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.3.4.3 Membrane-Forming Curing Compound

Provide liquid type compound conforming to ASTM C 309, Type 1, clear, Type

1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.4 MATERIALS

2.4.1 Cement

ASTM C 150, Type I or II or ASTM C 595, Type IP(MS) or IS(MS), IP(MH) IS(MH) blended cement except as modified herein. Provide blended cement that consists of a mixture of ASTM C 150, Type II, cement and one of the following materials: ASTM C 618 pozzolan or fly ash, ASTM C 989 ground granulated blast-furnace slag. For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials. Supplier must certify that the hazardous waste is neutralized by the manufacturing process and that no additional pollutants are discharged. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.4.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition must be 6 percent for Types N and F. Add with cement. Fly ash content must be a minimum of 15, 20, 30, 35, 40 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C 311. Evaluate and classify fly ash in accordance with ASTM D 5759.

High contents of supplementary cementitious materials can have some detrimental effects on the concrete properties, such as slowing excessively the strength gain rate, and delaying and increasing the difficulty of finishing. The recommended maximum content (by weight of the total cementitious material) for these materials are:

1. For GGBF slag: 50 percent

2. For fly ash or natural pozzolan: 40 percent (25 percent in cold climates)

3. For silica fume: 10 percent

2.4.1.2 Ground Granulated Blast-Furnace Slag

ASTM C 989, Grade 80, 100, 120. Slag content must be a minimum of 25, 50, 70 percent by weight of cementitious material.

2.4.1.3 Portland Cement

Provide cement that conforms to ASTM C 150, Type I, IA, II, or IIA. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.4.2 Water

Minimize the amount of water in the mix. The amount of water must not

exceed 45 percent by weight of cementitious materials (cement + pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and potable, from rainwater collection, from graywater, from recycled water; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

ASTM C 33, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalies in the cement.

Fine and coarse aggregates must show expansions less than 0.08 percent at 16 days after casting when testing in accordance with ASTM C 1260. Should the test data indicate an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C 1567 using the Contractor's proposed mix design. In this case, include the mix design low alkali portland cement and one of the following supplementary cementitious materials:

1. GGBF slag at a minimum of 40 percent of total cementitious

2. Fly ash or natural pozzolan at a minimum of total cementitious of
   a. 30 percent if ($SiO_2+Al_2O_3+Fe_2O_3$) is 65 percent or more,
   b. 25 percent if ($SiO_2+Al_2O_3+Fe_2O_3$) is 70 percent or more,
   c. 20 percent if ($SiO_2+Al_2O_3+Fe_2O_3$) is 80 percent or more,
   d. 15 percent if ($SiO_2+Al_2O_3+Fe_2O_3$) is 90 percent or more.

3. Silica fume at a minimum of 7 percent of total cementitious.

If a combination of these materials is chosen, the minimum amount must be a linear combination of the minimum amounts above. Include these materials in sufficient proportion to show less than 0.08 percent expansion at 16 days after casting when tested in accordance with ASTM C 1567.

Aggregates must not possess properties or constituents that are known to have specific unfavorable effects in concrete when tested in accordance with ASTM C 295.

2.4.3.1 Aggregates/Combined Aggregate Gradation (Floor Slabs Only)

ASTM C 33, uniformly graded and as follows: Nominal maximum aggregate size of 1 inch. A combined sieve analysis must indicate a well graded aggregate from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3mm). Provide sand that is at least 50 percent natural sand.

2.4.3.2 Aggregates for Lightweight Concrete

ASTM C 330.

2.4.3.3 Recycled Aggregate Materials

Use a minimum of 25 percent recycled aggregate, depending on local availability and conforming to requirements of the mix design. Recycled

aggregate to include: recovered glass, recovered concrete, recovered porcelain, recovered stone that meets the aggregate requirements specified. Submit recycled material request with the aggregate certification submittals and do not use until approved by the Contracting Officer.

2.4.4 Nonshrink Grout

ASTM C 1107/C 1107M.

2.4.5 Admixtures

ASTM C 494/C 494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.5.1 Air-Entraining

ASTM C 260.

2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494/C 494M, Type F and Type G (HRWR retarding admixture) and ASTM C 1017/C 1017M. Silica fume and HRWR must come from the same manufacturer.

2.4.5.3 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C 618.

2.4.6 Vapor Retarder and Vapor Barrier

ASTM D 4397 polyethylene sheeting, minimum 6, 10 mil thickness.

Waterproof Paper. Kraft paper, glass reinforcing fibers and layers of polyethylene laminated under heat and pressure to form a single layer meeting the requirements of FS UU-B-790, Type I, Grade A, Style 4; or waterproof paper, regular, conforming to ASTM C 171, consisting of two sheets of kraft paper cemented together with bituminous material in which are embedded cords or strands of fiber running in both directions not more than 1 1/4 inch apart.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.4.6.1 Water-Vapor Barrier Subgrade Cover

Provide cover that is water-resistant barrier paper, uncreped and reinforced, conforming to FS UU-B-790, Type I, Grade B, Style 4; or clear polyethylene sheeting, 6-mil, conforming to ASTM D 2103 and ASTM D 4397

2.4.7 Materials for Curing Concrete

Use water-based curing compounds, sealers, and coatings with low (maximum 160 grams/liter, less water and less exempt compounds), zero VOC content.

Consider the use of water based or vegetable or soy based curing agents in

lieu of petroleum based products. Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC). Consider the use of admixtures that offer high performance to increase durability of the finish product but also have low toxicity and are made from bio-based materials such as soy, and emit low levels of Volatile Organic Compounds (VOC).

2.4.7.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.7.2 Pervious Sheeting

AASHTO M 182.

2.4.7.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.4.8 Liquid Chemical Sealer-Hardener Compound

Provide magnesium fluorosilicate compound which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Provide compound that does not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.4.9 Expansion/Contraction Joint Filler

ASTM D 1751, ASTM D 1752, cork or 100% post-consumer paper meeting ASTM D 1752 (subparagraphs 5.1 to 5.4). Material must be 1/2 inch thick, unless otherwise indicated.

2.4.9.1 Preformed Joint Filler Strips

Provide nonextruding and resilient bituminous type filler strips conforming to ASTM D 1751.

Povide nonextruding and resilient nonbituminous type filler strips conforming to ASTM D 1752, Type I or II.

2.4.10 Joint Sealants

Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content.

2.4.10.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 1190 or ASTM C 920, Type M, Class 25, Use T. ASTM D 7116 for surfaces subjected to jet fuel.

2.4.10.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T. FS SS-S-1614, FS SS-S-200, no sag.

2.4.10.3 Waterstops

Provide waterstops that are flat dumbbell type, not less than 3/16 inch for

widths up to 5 inches, and not less than 3/8 inch for widths 5 inches and over.

Provide waterstops made of rubber and that conform to ASTM D 1752.

Provide waterstops made of polyvinylchloride (PVC) and that conform to ASTM C 990, ASTM D 2628.

2.4.10.4 Joint Sealant Compound

Provide hot-poured, elastic type compound conforming to ASTM D 1190.

Provide cold-applied, two-component, elastomeric polymer type compound conforming to FS SS-S-200.

2.4.11 Epoxy Bonding Compound

ASTM C 881/C 881M. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.4.12 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and rapeseed oil-based, soy oil-based, water-based, with a low (maximum of 55 grams/liter (g/l)), zero VOC content. A minimum of 85 percent of the total product must be biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.5 REINFORCEMENT

Galvanize bars, fabrics, connectors, and chairs.

2.5.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel. ASTM A 615/A 615M and AASHTO M 53 with the bars marked A, S, W, Grade 40, 60, 75; or ASTM A 996/A 996M with the bars marked R, Grade 50, 60, or marked A, Grade 40, 60. ASTM A 706/A 706M. Galvanized, ASTM A 123/A 123M. Zinc-coated (galvanized) bars, ASTM A 767/A 767M and ASTM A 780. Epoxy-coated reinforcing steel bars, ASTM A 775/A 775M. Epoxy-coated prefabricated steel reinforcing bars, ASTM A 934/A 934M. Provide reinforcing bars that contain a minimum of 100 percent recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Reinforcing bars may contain post-consumer or post-industrial recycled content.

2.5.1.1 Galvanized Reinforcing Bars

Provide galvanized reinforcing bars that conform to ASTM A 767/A 767M, Class II with galvanizing before fabrication.

2.5.1.2 Weldable Reinforcing Bars

Provide weldable reinforcing bars that conform to ASTM A 706/A 706M and ASTM A 615/A 615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

2.5.1.3 Epoxy-Coated Reinforcing Bars

Provide epoxy-coated reinforcing bars that conform to ASTM A 775/A 775M, Grade 40 or Grade 60.

2.5.2 Mechanical Reinforcing Bar Connectors

ACI/MCP-2. Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Wire

ASTM A 82/A 82M or ASTM A 496/A 496M.

2.5.3.1 Welded Wire Fabric

ASTM A 185/A 185M or ASTM A 497/A 497M. Provide fabric that contains a minimum of 100 percent recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Wire fabric may contain post-consumer or post-industrial recycled content. Provide flat sheets of welded wire fabric for slabs and toppings.

2.5.3.2 Steel Wire

Wire must conform to ASTM A 82/A 82M.

2.5.4 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material. Use recycled plastic with 100 percent recycled content. Use engineered resins from recycled ABS plastic, polycarbonates, and fiberglass.

2.5.5 Fiber-Reinforced Concrete

In addition to the requirements specified above, provide fiber reinforced concrete in accordance with ASTM C 1116/C 1116M Type III, synthetic fiber reinforced concrete, and as follows. Synthetic reinforcing fibers must be 100 percent virgin monofilament polypropylene fibers, with a minimum of 5, 10 percent post-consumer recycled content, or a minimum of 20, 40 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Fibers may contain post-consumer or post-industrial recycled content. Provide fibers that have a specific gravity of 0.9, a minimum tensile strength of 70 ksi, graded per manufacturer, and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement. Use a minimum of1.5 pounds of fibers per cubic yard of concrete. Add fibers at the batch plant. Toughness indices must meet requirements for performance level I. Provide the services of a qualified technical representative to instruct the concrete supplier in proper batching and mixing of materials to be provided.

2.5.6 Chairs and Bolsters: Plastic, Steel

Minimum 5, 10 percent post-consumer recycled content, or minimum 20, 40 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Plastic and steel may contain post-consumer or post-industrial recycled content

2.5.7 Dowels for Load Transfer in Floors

Provide dowels for load transfer in floors of the type, design, weight, and dimensions indicated. Provide dowel bars that are plain-billet steel conforming to ASTM A 615/A 615M, Grade 40. Provide dowel pipe that is steel conforming to ASTM A 53/A 53M.

2.5.8 Supports for Reinforcement

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Provide wire bar type supports conforming to ACI/MCP-3 and CRSI 10MSP.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6 BONDING MATERIALS

2.6.1 Concrete Bonding Agent

Provide aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound agent suitable for brush or spray application conforming to ASTM C 932.

2.6.2 Epoxy-Resin Adhesive Binder

Provide two-component, epoxy-polysulfide polymer type binder with an amine-type curing-agent conforming to FS MMM-A-001993, Type I or ASTM C 881/C 881M.

2.7 FLOOR FINISH MATERIALS

2.7.1 Liquid Chemical Floor Hardener

Hardener must be a colorless aqueous solution containing a blend of magnesium fluorosilicate and zinc fluorosilicate combined with a wetting agent. Solution must contain not less than 1/2 pounds of fluorosilicates per gallon. An approved proprietary chemical hardener may be used provided hardener is delivered ready for use in manufacturer's original containers.

2.7.2 Aggregate for Heavy-Duty Floor Topping

Provide emery (or may be traprock or traprock-screenings) fine aggregates, as specified.

Provide traprock that is packaged, crushed, natural, fine- to medium-grained igneous rock such as diabase, basalt, or black granite. Uniformly grade coarse aggregate with 100 percent passing 1/2-inch sieve, 30 to 50 percent passing 3/8-inch sieve, 0 to 15 percent passing No. 4 sieve, and 0 to 5 percent passing No. 8 sieve.

Provide fine aggregate using traprock that conforms to ASTM C 33, except gradation. Grade fine aggregate within the following limits:

SIEVE	PERCENT PASSING
3/8 inch	100
No. 4	95 to 100
No. 8	65 to 80
No. 16	45 to 65
No. 30	25 to 45
No. 50	5 to 15
No. 100	0 to 5

Deliver traprock coarse aggregate and fine aggregate in moisture-resistant bags.

2.8 CLASSIFICATION AND QUALITY OF CONCRETE

2.8.1 Concrete Classes and Usage

Provide concrete classes, compressive strength, requirements for air entrainment, and usage as follows:

CONCRETE CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH POUNDS PER SQ. IN.	REQUIREMENT FOR AIR ENTRAINMENT	USAGE
3A	3,000	Air-entrained	For foundation concrete work exposed to freezing and thawing or subjected to hydraulic pressure, such as foundation walls, grade beams, pits, tunnels. For exterior concrete slabs, such as steps, platforms, walks
3N	3,000	Nonair-entrained	For foundation concrete work not exposed to freezing and thawing or subjected to hydraulic pressure, such as footings, pile caps, foundation mats. For interior slabs on ground to be covered with resilient flooring

CONCRETE CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH POUNDS PER SQ. IN.	REQUIREMENT FOR AIR ENTRAINMENT	USAGE
4A	4,000	Air-entrained	For structural concrete work exposed to freezing and thawing, unless otherwise indicated or specified, such as exterior columns and spandrels
4N	4,000	Nonair-entrained	For structural concrete work not exposed to freezing and thawing such as interior columns, beams, supported slabs and other structural members for interior slabs on ground subjected to foot traffic
2.5A	2,500	Air-entrained	For concrete not reinforced and not exposed to freezing and thawing
2.5N	2,500	Nonair-entrained	For concrete not reinforced and not exposed to freezing and thawing
5A	5,000	Air-entrained	For structural concrete work as indicated
5N	5,000	Nonair-entrained	For structural concrete work as indicated

2.8.2 Limits for Concrete Proportions

Provide limits for maximum water/cement ratio and minimum cement content for each concrete class as follows:

CONCRETE CLASS	MAX. WATER/CEMENT RATIO BY WEIGHT	MIN. CEMENT FOR 3- TO 4-INCH SLUMP, (NO. OF 94-POUND SACKS) PER CU. YD.
2.5A	0.58	4.75
2.5N	0.62	4.75
3A	0.50	5.25
3N	0.54	5.25
4A	0.46	6.0

CONCRETE CLASS	MAX. WATER/CEMENT RATIO BY WEIGHT	MIN. CEMENT FOR 3- TO 4-INCH SLUMP, (NO. OF 94-POUND SACKS) PER CU. YD.
4N	0.48	6.0
5A	0.41	6.5
5N	0.44	6.5

* Weight of water to weight of cement in pounds in one cubic yard of concrete

2.8.3 Maximum Size of Aggregate

Size of aggregate, designated by the sieve size on which maximum amount of retained coarse aggregate is 5 to 10 percent by weight, must be as follows:

MAXIMUM SIZE OF AGGREGATE	ASTM C 33 SIZE NUMBER	TYPE OF CONSTRUCTION
2 inches	357	Nonreinforced footings and other flat work having a depth of not less than 6 inches, and nonreinforced walls and other formed sections having a dimension between forms of not less than 10 inches
1-1/2 inches	467	Monolithic slabs on ground, concrete fill, and other flat-work having a depth of not less than 5 inches and a clear distance between reinforcing bars of not less than 2 inches
3/4 inch	67	Reinforced walls, columns, girders, beams, and other formed sections having a dimension between forms of not less than 6 inches and clear distance between reinforcing bars or reinforcing bar and face of form of not less than 1 inch
3/4 inch	67	Monolithic concrete slabs and other flatwork having a depth of not less than 2-1/2 inches and a clear distance between reinforcing bars of not less than 1 inch
1/2 inch	7	Concrete joist construction, beams, reinforced walls, and other formed work having a clear distance between rein-

MAXIMUM SIZE OF AGGREGATE	ASTM C 33 SIZE NUMBER	TYPE OF CONSTRUCTION
		forcing bars and face of form of less than 1 inch
3/8 inch	8	Nonreinforced slabs and other flatwork having a depth of less than 2-1/2 inches

Maximum size of aggregate may be that required for most critical type of construction using that concrete class.

Specify gradation of aggregates for separate floor topping.

2.8.4 Slump

Provide slump for concrete at time and in location of placement as follows:

TYPE OF CONSTRUCTION	SLUMP
Footings, unreinforced walls	Not less than 1 inch nor more than 3 inches
Columns, beams, reinforced walls, monolithic slabs	Not less than 1 inch nor more than 4 inches
Ramps and other sloping surfaces	0 nor more than 3 inches

2.8.5 Total Air Content

Air content of exposed concrete and interior concrete must be in accordance with ASTM C 260 and/or as follows:

LIMITS CONCRETE EXPOSURE	REQUIREMENT FOR AIR ENTRAINMENT	MAXIMUM SIZE OF AGGREGATE	TOTAL AIR CONTENT BY VOLUME
Exposed to freezing and thawing or subjected to hydraulic pressure	Air-entrained	1-1/2 or 2 inches	4 to 6 percent
		3/4 inch	5 to 7 percent
		1/2 or 3/8 inch	6 to 8.5 percent

Provide concrete exposed to freezing and thawing or subjected to hydraulic pressure that is air-entrained by addition of approved air-entraining admixture to concrete mix.

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.

If substrate preparation is the responsibility of another installer, notify

Architect/Engineer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect/Engineer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified water barrier subgrade cover; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials and inspected by the Contractor for adequate compaction and surface tolerances as specified.

Actual density of top 12 inches of subgrade soil material-in-place must not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with ASTM D 1557.

SOIL MATERIAL	PERCENT MAXIMUM DENSITY
Drainage fill	100
Cohesionless soil material	100
Cohesive soil material	95

Finish surface of drainage fill under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

Cover drainage fill surface under interior slabs on ground with specified

water-vapor barrier subgrade cover immediately prior to placing reinforcement. Install subgrade cover to avoid puncture or tear. Patch punctures or tears over 12 inches with separate sheets lapped not less than 6 inches. Seal all punctures or tears less than 12 inches with pressure-sensitive vapor barrier tape not less than 2-inches wide. Seal lapped joints with vapor barrier adhesive or pressure-sensitive vapor barrier tape not less than 2-inches wide. Lay subgrade cover sheets with not less than a 6-inch lap at edges and ends and in direction in which concrete is to be placed.

Prepare subgrade or fill surface under exterior slabs on ground as specified for subgrade under foundations and footings.

3.2.4 Formwork

Complete and approve formwork. Remove debris and foreign material from interior of forms before start of concrete placing.

3.2.5 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.6 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

3.3 FORMS

ACI/MCP-2. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water must be watertight.

3.3.1 General

Construct forms to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms must be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.3.2 Design and Construction of Formwork

Provide formwork design and construction that conforms to and ACI/MCP-2, Chapter 4.

Provide forms that are tight to prevent leakage of cement paste during concrete placing.

Support form facing materials by structural members spaced close to prevent deflection of form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to ensure a smooth completed

surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, camber formwork for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Chamfer exposed joints, edges, and external corners a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Provide shores and struts with a positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Obtain adjustment with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, provide trussed supports.

Provide temporary openings in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Provide forms that are readily removable without impact, shock, or damage to concrete.

3.3.3 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.3.4 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, reshore slabs and beams over 10 feet in span and cantilevers over 4 feet for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Provide reshoring elements with the same load-carrying capabilities as original shoring and spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3.5 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.3.6 Forms for Standard Rough Form Finish

Give rough form finish concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish must be the specified concrete form plywood or other approved form facing material that produces concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Provide horizontal joints

that are level and vertical joints that are plumb.

3.3.7 Forms for Standard Smooth Form Finish

Give smooth form finish concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish must be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales must not exceed 0.0025 times the span.

Provide arrangement of form facing sheets that are orderly and symmetrical, and sheets that are in sizes as large as practical.

Arrange panels to make a symmetrical pattern of joints. Horizontal and vertical joints must be solidly backed and butted tight to prevent leakage and fins.

3.3.8 Form Ties

Provide ties that are factory fabricated metal, adjustable in length, removable or snap-off type that do allow form deflection or do not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts must be at least 1-1/2 inches back from concrete surface. Provide form ties that are free of devices that leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.3.9 Forms for Concrete Pan Joist Construction

Provide forms that are well-fitting, undamaged, factory-fabricated pan form units for concrete joist construction as indicated.

Form units complete with covers and end closures as required for the installation must be one of the following materials:

Steel, 16-gage, free from irregularities, dents, sag, and rust

Hardboard conforming to FS LLL-B-810, 1/4-inch thick, coated with waterproof plastic

Glass-fiber-reinforced plastic, molded under pressure, with matched dies, 0.11-inch maximum wall thickness

Asphalt-impregnated, corrugated material treated for moisture resistance with factory-applied polyethylene coating, with top and side cover joints taped where concrete is exposed.

Provide tight forms for concrete pan joist construction to prevent cement paste loss during concrete placing and to form a true, clean, smooth

surface, free of honeycomb and rough exposed-aggregate areas. Take precautions, including blocking of adjoining pan units, to avoid lateral deflection of formwork during compaction of concrete.

3.3.10 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI/MCP-1 and ACI/MCP-2.

3.3.11 Removal of Forms and Supports

After placing concrete, forms must remain in place for the time periods specified in ACI/MCP-4. Do not remove forms and shores (except those used for slabs on grade and slip forms) until the client determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Base such determination on compliance with one of the following:

a. The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

b. The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Prevent concrete damage during form removal. Clean all forms immediately after removal.

3.3.11.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39/C 39M test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.4 WATERSTOP SPLICES

Fusion weld in the field.

3.5 FORMED SURFACES

3.5.1 Preparation of Form Surfaces

Coat contact surfaces of forms with form-coating compound before reinforcement is placed. Provide a commercial formulation form-coating compound that does not bond with, stain, nor adversely affect concrete surfaces and impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Do not allow excess form-coating compound to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is placed. Make thinning of form-coating compound with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.5.2 Tolerances

ACI/MCP-4 and as indicated.

3.5.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which can impair the texture of the concrete surface.

3.6 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI/MCP-2. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.6.1 General

Provide details of reinforcement that are in accordance with, and ACI/MCP-4 and as specified.

3.6.2 Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape or cement joints. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement must not damage vapor barrier material. Place a 2 inch layer of clean concrete sand on vapor barrier before placing concrete.

3.6.3 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

ASTM A 934/A 934M. ASTM A 775/A 775M. Rest epoxy-coated reinforcing bars supported from formwork on coated wire bar supports, or on bar supports made of dielectric material or other acceptable material. Coat wire bar supports with dielectric material, compatible with concrete, for a minimum distance of 2 inches from the point of contact with the epoxy-coated reinforcing bars. Reinforcing bars used as support bars must be epoxy coated. Spreader bars, where used, must be epoxy coated. Make proprietary combination bar clips and spreaders used in construction with epoxy-coated reinforcing bars corrosion resistant or coated with dielectric material. Tie epoxy-coated bars with plastic-coated tie wire; or other materials acceptable to the Contracting Officer.

3.6.4 Epoxy Coated Reinforcing

Epoxy Coated Reinforcing must meet the requirements of ASTM A 934/A 934M including Appendix X2, ASTM A 775/A 775M including Appendix X1, "Guidelines for Job Site Practices" except as otherwise specified herein.

3.6.4.1 Epoxy Coated Reinforcing Steel Placement and Coating Repair

Carefully handle and install bars to minimize job site patching. Use the same precautions as described in paragraph for reinforcement delivery, handling, and storage when placing coated reinforcement. Do not drag bars over other bars or over abrasive surfaces. Keep bar free of dirt and grit. When possible, assemble reinforcement as tied cages prior to final placement into the forms. Support assembled cages on padded supports. It is not expected that coated bars, when in final position ready for concrete placement, are completely free of damaged areas; however, excessive nicks and scrapes which expose steel is cause for rejection. Criteria for defects which require repair and for those that do not require repair are as indicated. Inspect for defects and provide required repairs prior to assembly. After assembly, reinspect and provide final repairs.

a. Immediately prior to application of the patching material, manually remove any rust and debonded coating from the reinforcement by suitable techniques employing devices such as wire brushes and emery paper. Exercise cars during this surface preparation so that the damaged areas are not enlarged more than necessary to accomplish the repair. Clean damaged areas of dirt, debris, oil, and similar materials prior to application of the patching material.

b. Do repair and patching in accordance with the patching material manufacturer's recommendations. These recommendations, including cure times, must be available at the job site at all times.

c. Allow adequate time for the patching materials to cure in accordance with the manufacturer's recommendation prior to concrete placement.

d. Rinse placed reinforcing bars with fresh water to remove chloride contamination prior to placing concrete.

3.6.5 Splicing

As indicated. For splices not indicated ACI/MCP-2. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. AWS D1.4/D1.4M. Approve welded splices prior to use. Repair the cut ends of hot-dipped galvanized reinforcement steel to completely coat exposed steel, ASTM A 780.

3.6.6 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Calk the depression after the bolt is installed.

3.6.7 Cover

ACI/MCP-2 for minimum coverage, unless otherwise indicated.

3.6.8 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.6.9 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.6.10 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.6.11 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI/MCP-1, ACI/MCP-2 and ACI/MCP-3.

Provide hooks and bends that are in accordance with and ACI/MCP-3.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI/MCP-3.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required

shape, form, and cross-section area.

3.6.12 Placing Reinforcement

Place reinforcement in accordance withACI/MCP-4.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire fabric on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Contractor must cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between locating reinforcing and embedded items, the Contractor must notify the Contracting Officer so that conflicts may be reconciled before placing concrete. Anchors and embedded items must be positioned and supported with appropriate accessories.

Handle epoxy-coated reinforcing bars carefully to prevent damage to the coating. Use plastic-coated tie wire and supports of a type to prevent damage to the reinforcing bars.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and sufficiently heavy to carry the reinforcement they support, and in accordance with ACI/MCP-4 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

Equip supports on ground and similar surfaces with sand-plates.

Support welded wire fabric as required for reinforcing bars.

Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

With the exception of temperature reinforcement, tied to main steel approximately 24 inches on center, reinforcement must be accurately placed, securely tied at intersections with 18-gage annealed wire, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to ACI/MCP-3.

Bending of reinforcing bars partially embedded in concrete is permitted only as specified inand ACI/MCP-4.

3.6.13 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with theACI/MCP-3.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to approval.

3.6.14 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI/MCP-4, ASTM E 648,and ACI/MCP-3.

3.6.15 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

3.7 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94/C 94M, and ACI/MCP-2, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.7.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.7.2 Mixing

ASTM C 94/C 94M and ACI/MCP-2. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.7.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.8 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.8.1 General Placing Requirements

Deposit concrete continuously or in layers of such thickness that no concrete is placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation.

Concrete to receive other construction must be screeded to proper level to avoid excessive skimming or grouting.

Do not use concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials. Use of retempered concrete is permitted. Remove rejected concrete from the site.

3.8.2 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 4 inches greater than indicated.

3.8.3 Vibration

ACI/MCP-2 and ASTM A 934/A 934M, ASTM A 775/A 775M. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 20 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 20 inch maximum vertical lifts. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.8.4 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

3.8.5 Pumping

ACI/MCP-2. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.8.5.1 Pumping Lightweight Concrete

ACI/MCP-1. Presoak or presaturate aggregates. Cement content must be minimum of 564 pounds per cubic yard and be sufficient to accommodate a 4 to 6 inch slump. Make field trial run in accordance with ACI/MCP-1.

3.8.6 Cold Weather

ACI/MCP-2. Do not allow concrete temperature to decrease below 50 degrees F Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.8.7 Hot Weather

Maintain required concrete temperature using Figure 2.1.5 in ACI/MCP-2 to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.8.8 Follow-up

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

3.8.9 Placing Concrete in Forms

Deposit concrete placed in forms in horizontal layers not exceeding 24 inches.

Remove temporary spreaders in forms when concrete placing has reached elevation of spreaders.

Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Design vibrators to operate with vibratory element submerged in concrete and maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Provide vibrating equipment adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement is not be permitted. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Do not insert vibrator into lower courses of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Do not start placing of concrete in supporting elements until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.10 Placing Concrete Slabs

Place and consolidate concrete for slabs in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, consolidate concrete by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground by mechanical vibrators as specified. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other approved method. Limit consolidation operations to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated must be as dry as practical and surfaces thereof must not be manipulated prior to finishing operations. Bring concrete correct level with a straightedge and struck-off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface is not permitted.

Provide finish of slabs as specified.

3.8.11 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Apply such bonding material to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete must not vary more than the allowable tolerances of ACI/MCP-4. Exposed surfaces must be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

ACI/MCP-1 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch these holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.9.3.3 Standard Smooth Finish

Finish must be as-cast concrete surface as obtained with form facing

material for standard smooth finish. Repair and patch defective areas as specified; and all fins and remove other projections on surface.

3.9.4 Finish

Provide concrete indicated with a _____ finish as follows: _____.

3.9.5 Surface Finish Samples

Provide a minimum of three sample concrete panels for each finish for each mix design, 3 by 3 feet, 3 inches thick. Use the approved concrete mix design(s). Provide sample panels on-site at locations directed. Once approved, each set of panels must be representative of each of the finishes specified and of the workmanship and finish(es) required. Do not remove or destroy samples until directed by the Contracting Officer.

3.9.6 Grout Finish

Provide finish that is standard, smooth coated with grout as specified.

Give finish to interior and exterior concrete vertical surfaces that are to be exposed to view.

Grout is required consisting of one part portland cement to 1-1/2 parts fine aggregate by volume, mixed with water to produce a consistency of thick paint. Portland cement portion must be a blend of standard portland cement and white portland cement, proportioned as determined by trial mixes so that final color of grout when dry approximates color of surrounding concrete. Fine aggregate must pass No. 30 mesh sieve.

Surface of concrete is required to be wetted, and grout must be applied immediately to wetted surfaces. Spread grout over surface with clean burlap pads or sponge-rubber floats to fill pits, air bubbles, and surface holes. Remove excess grout by scraping, then rubbing surface with clean burlap to remove visible grout film. Keep grout damp by means of fog spray during setting period. Complete finish the day it is started, and make limits of a finished area at natural breaks in finished surface.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where quarry tile, or ceramic tile are indicated. Steel trowel and fine-broom finish concrete slabs that are to receive quarry tile, ceramic tile, or paver tile. Where straightedge measurements are specified, Contractor must provide straightedge.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious

applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below,roughen the surface with stiff brushes of rakes before final set.

3.10.1.2 Floated

Use for surfaces to receive roofing, waterproofing membranes, sand bed terrazzo, and exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float must begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, check surface with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. Cut down high spots and fill low spots during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.10.1.3 Steel Troweled

Use for floors intended as walking surfaces, and for reception of floor coverings. First, provide a floated finish. Next, the finish must be power troweled two, three times, and finally hand troweled. The first troweling after floating needs to produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings done by hand after the surface has hardened sufficiently. The final troweling is done when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by the hand troweling operations. The finished surface must be essentially free of trowel marks and uniform in texture and appearance. The finished surface must produce a surface level to within 1/4 inch in 10 feet. On surfaces intended to support floor coverings, remove any defects of sufficient magnitude to show through the floor covering by grinding.

3.10.1.4 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Apply dry shake aggregate of ceramically bonded aluminum oxide to the surface at a minimum rate of 25 pounds per 100 square feet. Blend approximately two-thirds of the aggregate with portland cement as recommended by the manufacturer and apply to the surface evenly and without segregation. After blended material has been embedded by floating, apply the remainder of the blended material to the surface at right angles to the previous application. Apply blended material heavier in any areas not sufficiently covered by the first application. Perform a second floating immediately following the first. After the selected material has been embedded by the two floatings, complete the operation with a broomed, floated, troweled finish.

3.10.1.5 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.10.1.6 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained. a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.10.1.7 Concrete Toppings Placement

The following requirements apply to the placement of toppings of concrete on base slabs that are either freshly placed and still plastic, or on hardened base slabs.

a. Placing on a Fresh Base: Screed and bull float the base slab. As soon as the water sheen has disappeared, lightly rake the surface of the base slab with a stiff bristle broom to produce a bonding surface for the topping. Immediately spread the topping mixture evenly over the roughened base before final set takes place. Give the topping the finish indicated on the drawings, specified herein.

b. Bonding to a Hardened Base: When the topping is to be bonded to a floated or troweled hardened base, roughen the base by scarifying, grit-blasting, scabbling, planing, flame cleaning, or acid-etching to lightly expose aggregate and provide a bonding surface. Remove dirt, laitance, and loose aggregate by means of a stiff wire broom. Keep the clean base wet for a period of 12 hours preceding the application of the topping. Remove excess water and apply a 1:1:1/2 cement-sand-water grout, and brush into the surface of the base slab. Do not allow the cement grout to dry, and spread it only short distances ahead of the topping placement. Do not allow the temperature differential between the completed base and the topping mixture to exceed 41 degrees F at the time of placing. Place the topping and finish as indicated, specified herein.

3.10.1.8 Heavy-Duty Wear-Resistant Finish

Give finish to slab surfaces where indicated.

Dry-shake material for heavy-duty, wear-resistant finish must consist of a mixture of standard portland cement and aggregate for heavy-duty, wear-resistant finish proportioned by weight as follows:

One part standard portland cement and two parts traprock aggregate for heavy-duty wear-resistant finish, four parts emery aggregate for heavy-duty wear-resistant finish, two parts by weight iron aggregate for heavy-duty, wear-resistant finish

Apply blended dry-shake material as follows:

MAXIMUM TYPE OF AGGREGATE IN DRY SHAKE	AMOUNT PER 100 SQUARE FEET OF SURFACE
Traprock	160 pounds
Emery	130 pounds
Iron	130 pounds

Immediately following the first floating operation, approximately one-half the specified weight of blended, uniformly distribute dry-shake materials over the surface and embedded by means of power floating. After the first dry-shake application has been embedded, uniformly distribute the remaining one-half of the blended dry-shake material over the surface at right angles to the first dry-shake application and embedded by means of power floating. Trueness of surface and other requirements for floating operations not specified in this paragraph must be as specified for float finish.

After completion of the float finish, trowel finish the surface as specified.

3.10.2 Flat Floor Finishes

ACI/MCP-2. Construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI/MCP-1 for tolerance tested by ASTM E 1155.

a. Specified Conventional Value:

Floor Flatness (Ff) 20 13 minimum
Floor Levelness (FL) 15 10 minimum

b. Specified Industrial:

Floor Flatness (Ff) 30 15 minimum
Floor Levelness (FL) 20 10 minimum

3.10.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

a. Key plan showing location of data collected.

b. Results required by ASTM E 1155.

3.10.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

3.10.3 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.5 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.10.6 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide, and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.11 CURING AND PROTECTION

ACI/MCP-2 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 General

Protect freshly placed concrete from premature drying and cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Start initial curing as soon as free water has disappeared from surface of concrete after placing and finishing. Keep concrete moist for minimum 72

hours.

Final curing must immediately follow initial curing and before concrete has dried. Continue final curing until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Prevent rapid drying at end of final curing period.

3.11.2 Moist Curing

Remove water without erosion or damage to the structure. Prevent water run-off.

3.11.2.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water must not be more than 50 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Provide sheeting that is at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.11.2.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.11.3 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout

the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI/MCP-2 indicates that hot weather conditions cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.11.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats must be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound must form a uniform, continuous, coherent film that does not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.11.3.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.11.4 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. Do not apply the sealer hardener until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.11.5 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods are required to be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

3.11.6 Curing Periods

ACI/MCP-2 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that is in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.11.7 Curing Methods

Accomplish curing by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

Moist curing:

Accomplish moisture curing by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water spraying

Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Place absorptive cover to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-cover curing:

Accomplish moisture-retaining cover curing by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Place cover directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Weight cover to prevent displacement; immediately repair tears or holes appearing during curing period by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing:

Accomplish membrane curing by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Apply curing compound uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Apply second coat in a direction at right angles to direction of first coat. Total coverage for two coats must be not more than 200 square feet per gallon of curing compound. Respray concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied by method and at rate specified. Maintain continuity of coating for entire curing period and immediately repair damage to coating during this period.

Membrane-curing compounds must not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.11.8 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.9 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified above, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.11.10 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.11 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.12 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C 143/C 143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C 39/C 39M. Make five test cylinders for each set of tests in

accordance with ASTM C 31/C 31M. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Take samples for strength tests of each mix design of and for concrete placed each day not less than once a day, nor less than once for each 160 cubic yards of concrete, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 450 psi, take a minimum of three ASTM C 42/C 42M core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Air Content

ASTM C 173/C 173M or ASTM C 231 for normal weight concrete and ASTM C 173/C 173M for lightweight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.2.5 Unit Weight of Structural Lightweight Concrete

ASTM C 567. Determine unit weight of lightweight concrete. Perform test for every 20 cubic yards maximum.

3.12.2.6 Ion Concentration

ACI/MCP-3. Determine water soluble ion concentration. Perform test once for each mix design.

3.12.2.7 Strength of Concrete Structure

Compliance with the following is considered deficient if it fails to meet the requirements which control strength of structure in place, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

3.12.2.8 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C 42/C 42M, and as follows:

Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

Test cores after moisture conditioning in accordance with ASTM C 42/C 42M if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.13 WASTE MANAGEMENT

3.13.1 Mixing Equipment

Before concrete pours, designate Company-owned site meeting environmental standards on-site area to be paved later in project for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.13.2 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.13.3 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier. Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.14 JOINTS

3.14.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Locate construction joints as follows:

a. In walls at not more than 60 feet in any horizontal direction; at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

d. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

Joints must be perpendicular to main reinforcement. Reinforcement must be continued across construction joints.

3.14.2 Waterstops

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Make field joints in waterstops in accordance with waterstop manufacturer's printed instructions, as approved. Protect waterstops protruding from joints from damage.

3.14.3 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.14.4 Control Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each control joint, cut 50 percent of welded wire fabric reinforcement before placing concrete.

Joints must be 1/8-inch wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface or by cutting the concrete with a saw after the concrete has set. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

In Hawaii, sawcutting will be limited to within 12 hours after set and at 1/4 slab depth.

3.14.5 Sealing Joints in Slabs on Ground

Isolation and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealing is not required for isolation and control joints to be covered with finish flooring material. Groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.15 INSTALLATION OF ANCHORAGE DEVICES

3.15.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, set and build in cast-in-place concrete as part of the work of this section, using setting drawings, instructions, and directions for work to be attached thereto.

3.15.2 Placing Anchorage Devices

Anchorage devices and embedded items must be positioned accurately and supported against displacement. Fill openings in anchorage devices such as slots and threaded holes with an approved, removable material to prevent entry of concrete into openings.

3.16 CONCRETE CONVEYING

3.16.1 Transfer of Concrete At Project Site

Handle concrete from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which prevent segregation and loss of concrete mix materials.

3.16.2 Mechanical Equipment for Conveying Concrete

Equipment must ensure a continuous flow of concrete at delivery end, as approved. Provide runways for wheeled concrete-conveying equipment from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment must be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

3.17 CONCRETE FLOOR TOPPING

3.17.1 Standard Floor Topping

Provide topping for treads and platforms of metal steel stairs and elsewhere as indicated.

Materials

Provide materials that conform to requirements specified, except aggregate must be as follows:

TYPE OF AGGREGATE	SIEVE	PERCENT PASSING
Fine aggregate	3/8 inch	100
	No. 4	95 to 100
	No. 8	80 to 90
	No. 16	50 to 75
	No. 30	30 to 50
	No. 50	10 to 20
	No. 100	2 to 5
Coarse aggregate	1/2 inch	100
	3/8 inch	95 to 100
	No. 4	40 to 60
	No. 8	0 to 5

Standard Topping Mixture

Provide mixture that consists of one part portland cement, one part fine aggregate, and two parts coarse aggregate, by volume. Adjust exact proportions of fine and coarse aggregates to produce a well-graded total aggregate. Mixing water must not exceed 5 gallons per 94-pound sack of cement including unabsorbed moisture in aggregate. Maximum slump must be 2 inches.

Preparations Prior to Placing

When mixture is placed on a green concrete base slab, screed surface of base slab to a level not more than 1-1/2 inches nor less than 1 inch below required finish surface. Remove water and laitance from surface of base slab before placing topping mixture. As soon as water ceases to rise to surface of base slab, place topping mixture as specified.

When mixture is placed on a hardened concrete base slab, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from base slab surface, leaving a clean surface. Prior to placing topping mixture, (2-1/2-inches minimum) slab surface must be dampened

and left free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Do not allow cement grout to set or dry before topping mixture is placed.

When mixture is placed on a metal surface, such as metal pans for steel stairs, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from metal surface. Immediately before topping mixture is placed, spray or brush a coating of concrete bonding agent onto metal surfaces and do not be allow to set or dry before topping mixture is applied.

Mixing

Do the mixing of topping material at the site in a mechanical mixer of the batch type. Equip batch mixer with a suitable charging hopper, water storage tank, and water-measuring device and must be capable of mixing aggregates, cement, and water into a uniform mix within specified mixing time and of discharging mix without segregation. Provide mixer that bear a rating plate indicating rated capacity and recommended revolutions per minute.

Mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes. Increase mixing time 15 seconds for each additional cubic yard or fraction thereof.

Clean mixer, and replace blades in drum when they have lost 10 percent of their original depth.

Truck-mixed topping may be used when approved. Specify truck-mixed topping for ready-mix concrete.

Placing

Spread standard topping mixture evenly on previously prepared base slab or metal surface, brought to correct level with a straightedge, and struck off. Topping must be consolidated, floated, checked for trueness of surface, and refloated as specified for float finish.

Finishing

Give trowel finish standard floor topping surfaces.

Give other finishes standard floor topping surfaces as indicated. Specify such finishes for required finish.

3.17.2 Heavy-Duty Floor Topping

Provide topping where indicated.

Heavy-duty Topping Mixture

Provide mixture that consists of 1 part portland cement and 2-1/2 parts emery aggregate or 1 part fine aggregate and 1-1/2 parts traprock coarse aggregate, by volume. Exact proportions of mixture must conform to recommendations of aggregate manufacturer. Mixing water must not exceed 3-1/4 gallons per 95-pound sack of cement including unabsorbed moisture in aggregate. Maximum slump must be 1 inch.

Base Slab

Screed surface of slab to a level no more than 1-1/2 inches nor less than 1 inch below grade of finished floor.

Give slab a scratch finish as specified.

Preparations prior to placing

Remove dirt, loose material, oil, grease, asphalt, paint and other contaminants from base slab surface. Prior to placing topping mixture, dampen slab surface and leave free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Allow cement grout to set or dry before topping mixture is placed.

Mixing

Do mixing of topping material at the site in a mechanical mixer of the batch type. Equip batch mixer with a charging hopper, water storage tank, and a water-measuring device and the batch mixer must be capable of mixing aggregates, cement, and water into a uniform mix within the specified mixing time and of discharging mix without segregation. Provide mixer that bears a rating plate indicating rated capacity and recommended revolutions per minute.

Mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes.

Increase mixing time 15 seconds for each additional cubic yard or fraction thereof. Clean mixer, and replace pick-up and throw-over blades in drum when they have lost 10 percent of their original depth.

Placing

Spread heavy-duty topping mixture evenly on previously prepared base slab, and bring to correct level with a straightedge, and strike off. Provide topping that is consolidated, floated, and checked for trueness of surface as specified for float finish, except that power-driven floats is the impact type.

Finishing

Give trowel finish heavy-duty floor topping surfaces. Provide trowel finish as specified, except that additional troweling after first power troweling must be not less than three hand-troweling operations.

-- End of Section --

SECTION 03 30 50

CAST-IN-PLACE CONCRETE

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 301	(1999) Standard Specifications for Structural Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 306R	(1988) Cold Weather Concreting

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 33	(1999ael) Concrete Aggregates
ASTM C 94/C94M	(2000) Ready-Mixed Concrete
ASTM C 143/C143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 156	(1998) Water Retention by Concrete Curing Methods
ASTM D 1140	(2000) Amount of Material in Soils Finer Than the No. 200 (75-micrometer) Sieve

PART 2 PRODUCTS

2.1 CONCRETE

ASTM C 94/C94M, a minimum strength of 2500 psi at 28 days and slump between 2 and 4 inches ASTM C 143/C143M.

2.2 CURING MATERIALS

ACI 301.

2.3 CONCRETE AGGREGATE

ASTM C 33, fine aggregate grading with a maximum of 3 percent by weight

passing ASTM D 1140, No. 200 sieve, or coarse aggregate Size 57, 67, or 7.

2.4 REINFORCING STEEL

ASTM A 615/A 615M, Grade 60.

2.5 WELDED-WIRE FABRIC FOR CONCRETE REINFORCEMENT

ASTM A 185.

2.6 VAPOR BARRIER

Shall be polyethylene sheeting of natural color with a nominal thickness of 0.004-inch. The loss of moisture when determined in accordance with ASTM C 156 shall not exceed 0.055 gram per square centimeter of surface.

PART 3 EXECUTION

3.1 FILL

Under the areas to receive concrete shall be compacted to 95% density.

3.2 WORKMANSHIP

The surface immediately under concrete installed on grade shall be wetted as directed immediately before the concrete is placed.

3.3 CURING

Curing concrete shall conform to ACI 301.

3.4 CONCRETE FINISHES

Concrete shall be given a floated finish.

3.5 HOT WEATHER CONCRETE WORK

ACI 305R.

3.6 COLD WEATHER CONCRETE WORK

ACI 306R.

-- End of Section --

SECTION 03 52 00

LIGHTWEIGHT CONCRETE ROOF INSULATION

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP	(2005) Fundamentals Handbook, I-P Edition

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 332	(2007) Lightweight Aggregates for Insulating Concrete
ASTM C 495	(2007) Compressive Strength of Lightweight Insulating Concrete
ASTM C 513	(1989; R 1995) Obtaining and Testing Specimens of Hardened Lightweight Insulating Concrete for Compressive Strength
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 612	(2004) Mineral Fiber Block and Board Thermal Insulation
ASTM C 796	(2004) Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam

1.2 QUALIFICATIONS OF APPLICATOR

Perform work by or under the supervision of personnel specializing in insulating concrete application and having not less than 2 years experience.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Performance requirements

Submit, indicating compressive strength, oven dry density, and coefficient of heat transmission.

SD-06 Test Reports

Performance requirements

Submit certified test reports on laboratory testing of insulating concrete samples taken at time of placement.

SD-07 Certificates

Fabricator's Compatibility Certificates

SD-08 Manufacturer's Instructions

Application

1.4 DELIVERY AND STORAGE

Deliver all materials to the building site in original unopened, undamaged packages or containers, or approved bulk handling equipment, with manufacturer's brand name and contents clearly identified. Protect materials against dampness. Store materials under cover and off the ground, in well-ventilated areas, not exposed to extreme changes of temperature and humidity. Prevent deterioration or intrusion of foreign substances. Keep materials dry until ready for use. Protect metal components from rusting.

1.5 ENVIRONMENTAL CONDITIONS

1.5.1 Normal Conditions

When ambient air temperatures of 40 degrees F or above are predicted for the initial 24 to 72 hours after placement of insulating concrete, the use of hot water and other cold weather protection measures are not required.

1.5.2 Cold Weather Conditions

When ambient air temperature at time of placing insulating concrete is between 40 and 32 degrees F, use hot water in temperature range of 90 to 120 degrees F at the point of placement. When ambient air temperatures of 32 degrees F or below are predicted for the initial 24 to 72 hours after placement of insulating concrete, provide additional protection measures as recommended by the aggregate manufacturer.

1.6 SAFETY AND HEALTH REQUIREMENTS

Comply with manufacturer's protective measures in the safe installation of the insulation board.

1.7 QUALITY ASSURANCE

1.7.1 Fabricator's Compatibility Certificates

Submit a written statement from the insulating concrete fabricator certifying that materials for this project are chemically and physically compatible.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT

ASTM C 150, Type I, II, III.

2.2 AGGREGATE

ASTM C 332, Group I.

2.3 AIR-ENTRAINMENT

The air-entrainment agent shall be prepackaged or added at the mixer. Provide amount and type of air-entrainment in accordance with the aggregate manufacturer's recommendations. Do not use calcium chloride.

2.4 FOAMING AGENTS

ASTM C 796.

2.5 WATER

Water shall be clean and free from injurious amounts of acids, alkali, organic matter, or other deleterious substances.

2.6 EXPANSION JOINT FILLER MATERIAL

ASTM C 612, Class 1, semi-rigid, modified for maximum density of 6.0 pounds per cubic foot.

2.7 WELDED WIRE FABRIC

Galvanized steel welded wire fabric shall conform to ASTM A 185/A 185M.

2.8 INSULATION BOARD

Polystyrene insulation board conforming to ASTM C 578 RCPS Type I, II, III, IV, or V, 24 by 48 inches, and of thickness indicated, necessary to provide a "C" value not greater than _____. Boards shall be factory fabricated and slotted or perforated for keying the insulation board into the insulating concrete.

PART 3 EXECUTION

3.1 PERFORMANCE REQUIREMENTS

Provide insulating concrete design mix to shall meet the following performance requirements. Test as specified.

3.1.1 Minimum Compressive Strength

125 pounds per square inch in 28 days as tested with ASTM C 495.

3.1.2 Minimum Oven Dry Density

22 pounds per cubic foot as determined by ASTM C 495.

3.1.3 Coefficient of Heat Transmission

U value of 0.05 Btu/hr/sq. ft/degree F, as determined in accordance with ASHRAE FUN IP. The U value shall incorporate the total roof deck and roofing system design and represent the average U value for the total roof area.

3.2 SURFACE PREPARATION

Clean surfaces to receive insulating concrete of dirt, debris, and other foreign materials that would affect bonding. Deck shall be free of standing water, snow, and ice.

3.3 STEEL ROOF DECKING

As specified in Section 05 30 00 STEEL DECKS.

CAST-IN-PLACE, PRECAST STRUCTURAL CONCRETE DECK

As specified.

3.4 REINFORCING MESH OR WELDED WIRE FABRIC

Install reinforcing mesh or welded wire fabric with a minimum end lap of 6 inches and no side lap. Cut mesh or fabric to fit at all walls, curbs, roof drains, and openings. Mesh not required over structural concrete decks.

3.5 APPLICATION OF INSULATING CONCRETE AND INSULATION BOARD

Apply insulating concrete, insulation board and related materials in accordance with respective specifications and manufacturer's instructions, except as modified herein.

3.5.1 Mixing

Mix insulating concrete materials mechanically to produce a uniform distribution.

3.5.2 Conveying

Convey insulating concrete from the mixer to place of final deposit by methods that prevent segregation or loss of materials. Convey the concrete without material separation or loss of air content.

3.5.3 Expansion Joints

Provide expansion joints through the depth of the light-weight insulating concrete at the perimeters of the roof deck, where the roof deck abuts vertical surfaces and where indicated. Perimeter expansion joints are not required with cellular concrete.

3.5.4 Slurry Coat and Insulation Board

Bond the insulation board to the structural deck with a slurry coat of the same insulating concrete mix ratio as used for fill over the insulation board. Screed the slurry of concrete to an even surface, to a minimum of 1/8 inch over the top of the structural deck. Fill corrugations of steel decking with insulating concrete and screed even with the slurry coat.

3.5.5 Insulating Concrete Fill

Place the insulating concrete on the insulation board and screed to an even surface in a continuous operation until placement of a section is completed. Provide slopes as indicated for high points, valleys and positive drainage to roof drains and to eliminate ponding. At no place shall the minimum and maximum thickness of the insulating concrete be less than 2 inches or greater than 8 inchesrespectively over the top of insulation board.

3.5.5.1 Compacting

Rodding, tamping, or vibrating are not permitted.

3.5.5.2 Curing

Minimize traffic on the surface during the curing period. Under normal conditions, roofing may begin in 3 days. When the insulating concrete is placed during extremely dry conditions, sprinkle additional water on the concrete for hydration of the cement and to minimize shrinkage cracking. After a freezing or heavy rainfall or minor scaling of less than 1/4 inch depth, broom the surface immediately prior to installation of roofing.

3.5.5.3 Patching

Remove portions of the insulating concrete deck with excessive scaling of more than 1/4 inch depth to sound concrete. Patch the surface with portland cement concrete slurry.

3.6 FIELD TESTS

During progress of work, insulating concrete specimens shall be taken for laboratory testing as specified herein.

3.6.1 Test Specimens

Take test cylinder specimens for compressive strength in the presence of the Contracting Officer. Notify the Contracting Officer one day prior to the date of taking specimens. A minimum of four test specimens shall be made for each day's concreting, with at least one test required for each 75 cubic yards of insulating concrete. Label specimens to indicate the location at which they were taken. Store specimens in an undisturbed place which will not be exposed to rain and extreme changes of temperature and humidity until ready for testing.

3.6.2 Rejections

If the specified laboratory requirements are not met, the rejected insulating concrete shall be field tested for the compressive strength. Determine oven-dry unit weight with ASTM C 513. Remove and replace

insulating concrete which does not meet the requirements specified with new insulating concrete roof deck materials.

-- End of Section --

SECTION 04 20 00

MASONRY

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318/318R	(2005; Errata 2005) Building Code Requirements for Structural Concrete and Commentary
ACI 530	(2005) Building Code Requirements for Masonry Structures Commentaries
ACI 530.1	(2005) Specification for Masonry Structures
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 615/A 615M	(2007) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 641/A 641M	(2003) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM B 370	(2003) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C 1019	(2007) Standard Test Method for Sampling and Testing Grout
ASTM C 1072	(2006) Standard Test Method for Measurement of Masonry Flexural Bond Strength

ASTM C 1142	(1995; R 2007) Standard Specification for Extended Life Mortar for Unit Masonry
ASTM C 1289	(2007) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 129	(2006) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C 140	(2007a) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 216	(2007a) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 27	(1998; R 2002) Fireclay and High-Alumina Refractory Brick
ASTM C 270	(2007a) Standard Specification for Mortar for Unit Masonry
ASTM C 315	(2007) Clay Flue Linings
ASTM C 476	(2007) Standard Specification for Grout for Masonry
ASTM C 494/C 494M	(2005a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 55	(2006e1) Concrete Brick
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 593	(2006) Fly Ash and Other Pozzolans for Use with Lime
ASTM C 62	(2005) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 641	(2007) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(2007) Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C 67	(2007a) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 744	(2005) Prefaced Concrete and Calcium

	Silicate Masonry Units
ASTM C 780	(2007a) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 90	(2006b) Loadbearing Concrete Masonry Units
ASTM C 91	(2005) Masonry Cement
ASTM C 94/C 94M	(2007) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2006) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 2000	(2006ae1) Standard Classification System for Rubber Products in Automotive Applications
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2287	(1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(2007a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 514	(2006) Water Penetration and Leakage Through Masonry
INTERNATIONAL CODE COUNCIL (ICC)	
ICC IBC	(2006; Errata 2006; Errata 2007; Supplement 2007; Errata 2007) International Building Code
U.S. DEPARTMENT OF DEFENSE (DOD)	
UFC 3-310-04	(2007) Seismic Design for Buildings
U.S. GREEN BUILDING COUNCIL (USGBC)	
LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL

PROCEDURES:

SD-02 Shop Drawings - Unless provided by Government

Structural Masonry

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-03 Product Data

Local/Regional Materials (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data
Clay or Shale Brick (LEED)
Concrete Brick
Concrete Masonry Units (CMU)(LEED)
Cement (LEED)
Insulation
Flashing
Water-Repellant Admixture

Manufacturer's descriptive data. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Cold Weather Installation

Cold weather construction procedures.

Salvaged Brick (LEED)

Documentation certifying products are from salvaged/recovered sources. Indicate relative dollar value of salvaged content products to total dollar value of products included in project.

SD-04 Samples

Concrete Masonry Units (CMU)
Concrete Brick
Stone Items
Clay or Shale Brick

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture. Submit sample of colored mortar with applicable masonry unit.

Anchors, Ties, and Bar Positioners

Two of each type used.

Expansion-Joint Materials

One piece of each type used.

Joint Reinforcement

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation

One piece of board type insulation, not less than 16 by 24 inches in size, containing the label indicating the rated permeance and R-values.

Portable Panel

One panel of clay or shale brick, 2 by 2 feet, containing approximately 24 brick facings to establish range of color and texture.

SD-05 Design Data

Pre-mixed Mortar
Unit Strength Method

Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.

SD-06 Test Reports

Efflorescence Test
Field Testing of Mortar
Field Testing of Grout
Prism tests
Masonry Cement
Fire-rated CMU

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection

Copies of masonry inspector reports.

SD-07 Certificates

Clay or Shale Brick
Concrete Brick
Concrete Masonry Units (CMU)
Control Joint Keys
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Joint Reinforcement
Reinforcing Steel Bars and Rods
Masonry Cement
Mortar Coloring
Insulation
Precast Concrete Items
Admixtures for Masonry Mortar
Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

Insulation

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Contamination

SD-08 Manufacturer's Instructions

Masonry Cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

SD-10 Operation and Maintenance Data

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, a portable panel of clay or shale brick and sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the

wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 4, 6 feet high.

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner, a stacked bond corner, that includes a bond beam corner. Panels shall show parging and installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C 90. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.5 STRUCTURAL MASONRY

1.5.1 Special Inspection - If indicated by Specification

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

1.5.2 Seismic Requirement

In addition to design requirements of ICC IBC, the Contractor shall provide additional seismic reinforcement in accordance with UFC 3-310-04, as detailed on the drawings, sketches which are attached at the rear of this section. The total minimum reinforcing percentage for structural walls shall be 0.20 percent and non-structural walls shall be 0.15 percent. The maximum spacing of reinforcing bars shall be as follows:

Wall Type	Vertical	Horizontal
Structural	24 inches	48 inches
Non-structural	48 inches	80 inches

Bond beams are required at the top of footings, at the bottom and top of openings at roof and floor levels, and at the top of parapet walls.

1.6 QUALITY ASSURANCE

1.6.1 Appearance

Bricks shall be manufactured at one time and from the same batch. Blend all brick to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable.

1.6.2 Testing

Masonry strength shall be determined in accordance with ACI 530; submit test reports on three prisms as specified in ACI 530.1. The cost of testing shall be paid by the Contractor.

1.6.3 Spare Vibrator

Maintain at least one spare vibrator on site at all times.

1.6.4 Bracing and Scaffolding

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Masonry materials may be locally available.

1.7.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Brick shall conform to ASTM C 62; Grade SW shall be used for brick in contact with earth or grade and for the first six exterior courses above grade, all exterior work and for all nonvertical surfaces. Grade SW or MW shall be used in other brickwork. Average dimensions of brick shall be 3-5/8 inches thick, 2-1/4 inches high,

and 8 inches long (standard) or 4 inches thick, 2-2/3 inches high, and 8 inches long (nominal), subject to the tolerances specified in ASTM C 62. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall. Clay units shall contain a minimum of 5, 10 percent post-consumer recycled content, or a minimum of 20, 40 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Clay units may contain post-consumer or post-industrial recycled content.

2.2.1 Solid Clay or Shale Brick

Solid clay or shale brick shall conform to ASTM C 62, ASTM C 216, Type FBS, FBA, FBX. Brick size shall be modular and the nominal size of the brick used shall be 3-5/8 inches thick, 2-1/4 inches high, and 8 inches long (nominal) or 4 inches thick, 2-2/3 inches high and 8 inches long (nominal). Minimum compressive strength of the brick shall be _____ psi.

2.2.2 Hollow Clay or Shale Brick

Hollow clay or shale brick shall conform to ASTM C 652, Type HBS, HBX, HBA, HBB. Brick size shall be modular and the nominal size of the brick used shall be _____ inches thick, _____ inches high, and _____ inches long. Where vertical reinforcement is shown in hollow brick, the minimum cell dimension shall be 2-1/2 inches and the units shall be designed to provide precise vertical alignment of the cells. Minimum compressive strength of the brick shall be _____ psi.

2.2.3 Refractory Brick

ASTM C 27, low-duty type, _____ inches thick, _____ inches high, and _____ inches long.

2.3 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Grade N, S. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

2.4 CONCRETE MASONRY UNITS (CMU)

Cement shall have a low alkali content and be of one brand. Units shall contain a minimum of 5, 10 percent post-consumer recycled content, or a minimum of 20, 40 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Units may contain post-consumer or post-industrial recycled content. Units shall be of modular dimensions and air, water, or steam cured. Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide bond; elsewhere, exposed surfaces of units shall be smooth and of uniform texture. Exterior concrete masonry units shall have water-repellant admixture added during manufacture.

a. Hollow Load-Bearing Units: ASTM C 90, made with lightweight or medium weight, or normal weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Hollow Non-Load-Bearing Units: ASTM C 129, made with lightweight or medium weight, or normal weight aggregate. Load-bearing units may

be provided in lieu of non-load-bearing units.

c. Solid Load-Bearing Units: ASTM C 90, lightweight or medium weight, or normal weight units. Provide solid units for masonry bearing under structural framing members, as indicated.

2.4.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification. Use industrial waste by-products (air-cooled slag, cinders, or bottom ash), ground waste glass and concrete, granulated slag, and expanded slag in aggregates. Slag shall comply with ASTM C 989; Grade 80, 100, 120.

2.4.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.4.2.1 Architectural Units

Units shall have patterned face shell. Face shell pattern shall be fluted, vertical scored, split ribbed. Units shall be integrally colored during manufacture. Color shall be _____. Patterned face shell shall be properly aligned in the completed wall.

2.4.2.2 Patterned, Decorative Screen Units

Patterned, decorative screen units shall conform to the applicable requirements of ASTM C 90, ASTM C 129. Units shall have uniform through-the-wall pattern, color, and texture.

2.4.3 Fire-Rated CMU

Concrete masonry units used in fire-rated construction shown on the drawings shall be of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated on the aggregate requiring the greater minimum equivalent thickness to produce the required fire rating. Construction shall conform to ASTM E 119.

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

Minimum equivalent thickness inches for fire rating of:

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

Aggregate Type	See note (a) below 4 hours	3 hours	2 hours
Pumice	4.7	4.0	3.0
Expanded slag	5.0	4.2	3.3
Expanded clay, shale, or slate	5.7	4.8	3.7
Limestone, scoria, cinders or unexpanded slag	5.9	5.0	4.0
Calcareous gravel	6.2	5.3	4.2
Siliceous gravel	6.7	5.7	4.5

Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in inches. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be included in determining the equivalent thickness.

2.5 PRECAST CONCRETE ITEMS

Trim, lintels, copings, splashblocks and door sills shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4,000, 3000 psi minimum conforming to Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 30 00 CAST-IN-PLACE CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.5.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to

the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure. In reinforced masonry, lintels shall conform to ACI 318/318R for flexural and shear strength and shall have at least 8 inches bearing at each end. Concrete shall have a minimum 28 day compressive strength of _____ psi using 1/2 inch to No. 4 nominal-size coarse aggregate. Reinforcement shall conform to ASTM A 615/A 615M Grade 60,000 psi. Limit lintel deflection due to dead plus live load to L/600 or 0.3 inches. Provide top and bottom bars for lintels over 36 inches in length.

2.5.2 Sills and Copings

Sills and copings shall be cast with washes. Sills for windows having mullions shall be cast in sections with head joints at mullions and a 1/4 inch allowance for mortar joints. The ends of sills, except a 3/4 inch wide margin at exposed surfaces, shall be roughened for bond. Treads of door sills shall have rounded nosings. Reinforce sills with not less than two No. 4 bars.

2.5.3 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.5.4 Flue Linings and Thimbles

ASTM C 315, free from fractures. Sizes and shapes shall be as indicated.

2.6 MORTAR FOR STRUCTURAL MASONRY

ASTM C 270, Type M, N, S. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Use Type I, II, III portland cement. Use Type IS, IP, I(PM) blended hydraulic cement. Use Masonry cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 18 percent in masonry cement mortar. Use up to 40 percent Class F fly ash with type IP cement in cement-lime mortar. Fly ash shall comply with ASTM C 593.

2.7 MASONRY MORTAR

Type M mortar shall conform to ASTM C 270 and shall be used for foundation walls , basement walls, and pier. Mortar Type S, N shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate. Type N or S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; approved commercial fire clay mortar or refractory cement (calcium-aluminate) mortar for fire brick and flue liners; and Type S for remaining masonry work; except where higher compressive strength is indicated on structural drawings. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one

source.

2.7.1 Colored Mortar

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color matching _____. Quantity of pigment to cementitious content of the masonry cement shall not exceed 5 by weight; carbon black shall not exceed 1 percent by weight. Quantity of pigment to cementitious content of cement-lime mix shall not exceed 10 percent by weight, carbon black no more than 2 percent by weight. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement. Compressive strength of colored mortar shall equal ____.

2.7.2 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207, Type S, SA.

2.7.3 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C 1142, Type RN,, RS, RM.

2.7.4 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.8 WATER-REPELLANT ADMIXTURE

Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units conforming to ASTM C 744 and mortar which contain the water-repellant admixture. When tested in accordance with ASTM C 1072, such panels shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E 514, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.

2.9 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, fine, coarse. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10, or 11 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

2.9.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.

2.9.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.10 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82/A 82M. Wire ties or anchors in exterior walls shall conform to ASTM A 641/A 641M. Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A 641/A 641M; coordinate with paragraph JOINT REINFORCEMENT below. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.10.1 Wire Mesh Ties

Wire mesh for tying 4 inch thick concrete masonry unit partitions to other intersecting masonry partitions shall be 1/2 inch mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 12 inches.

2.10.2 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.10.3 Dovetail Anchors

Dovetail anchors shall be of the flexible wire type, 3/16 inch diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 30 00 CAST-IN-PLACE CONCRETE.

2.10.4 Adjustable Anchors

Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.10.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.11 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82/A 82M, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.12 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.13 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.14 INSULATION

2.14.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C 578. Polyisocyanurate shall conform to ASTM C 1289, Type I, Class 1 or 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

2.14.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 2 inches, and a minimum air space of 3/4 inch.

2.14.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 11 for the overall

thickness. The aged R-value shall be determined at 75 degrees F in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.14.1.3 Recovered Material

Contractor shall comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERD MATERIALS. The polyurethane or polyisocyanurate foam shall have a minimum recovered material content of ____ percent by weight of the core material.

2.14.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

2.15 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07 92 00 JOINT SEALANTS, and shall be penetrating with a maximum volatile organic compound (VOC) content of 600 grams/liter.

2.16 FLASHING

Flashing shall be as specified in Section 07 60 00 FLASHING AND SHEET METAL. Provide one of the following types except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing and except that the material shall be one which is not adversely affected by dampproofing material.

a. Coated-Copper Flashing: 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory apply coating to a weight of not less than 6 ounces/square foot (approximately 3 ounces/square foot on each side).

b. Copper or Stainless Steel Flashing: Copper, ASTM B 370, minimum 16 ounce weight; stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 0.015 inch thick, No. 2D finish. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

c. Reinforced Membrane Flashing: Polyester film core with a reinforcing fiberglass scrim bonded to one side. The membrane shall be impervious to moisture, flexible, and not affected by caustic alkalis. The material, after being exposed for not less than 1/2 hour to a temperature of 32 degrees F, shall show no cracking when, at that temperature, it is bent 180 degrees over a 1/16 inch diameter mandrel and then bent at the same point over the same size mandrel in the

opposite direction 360 degrees.

2.17 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum, plastic or wood blocking sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage of moisture from cavities and to prevent the entrance or insects. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection. Conform to ACI 530.1 for hot and cold weather masonry erection.

3.1.2.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F

b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 to 20 degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.1.3 Stains

Potect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.1.5 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running, stacked, the indicated bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped

edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view. Lay fire brick by dipping each brick in a soft mixture of fire clay and water and then rubbing the brick into place with joints as thin as practicable or provide refractory mortar with joints not more than 3/8 inch thick.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid. Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.4.4 Brick-Faced Walls

For brick-faced walls bond the two wythes in every sixth brick course with continuous horizontal joint reinforcement, bond brick in the pattern as indicated on the drawings. Provide additional bonding ties spaced not more than 3 feet apart around the perimeter of and within 12 inches of all openings.

a. Collar Joints: Fill collar joints solid with mortar as each course of brick is laid. Do not disturb units in place.

b. Brick Sills: Lay brick on edge, slope, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

3.2.4.5 Cavity Walls

Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings. At the bottom of cavity walls, in the course immediately above the through-wall flashing, temporarily omit one brick every 4 feet. With a hose and clean water, wash all mortar droppings and debris out of the cavity through the temporary openings at least twice each day masonry is laid, and more often when required to keep the cavities clean. Fill in the openings with bricks and mortar after the wall is complete and the cavity has been inspected and

found clean. Provide weep holes of open head joints spaced 24 inches o.c. wherever the cavity is interrupted, at base of wall and vertical obstructions (e.g. lintels). Cavity face of interior wythe shall be dampproofed in accordance with Section 07 11 13 BITUMINOUS DAMPPROOFING.

3.2.4.6 Reinforced Brick Walls

Provide two wythes of brick separated by a _____ inch wide continuous space filled with grout, bricks "floated" in grout and reinforced as indicated. Bevel mortar beds away from grout space to prevent projection into grout space when bricks are shoved in place. Deeply furrowed bed joints will not be permitted. Lay exterior wythe of brick to the height of each grout pour in advance of interior wythe. Clean grout space and set reinforcing before laying interior wythe. Provide metal ties to prevent spreading of the wythes and to maintain vertical alignment of walls. Position reinforcing as indicated. Wire vertical reinforcing securely in position as the brickwork progresses. Use puddling rod or vibrator to consolidate the grout. The minimum clear distance between parallel bars shall be the nominal diameter of the bars; the minimum clear distance between masonry and reinforcing shall be 1/4 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together. Stagger splices in adjacent horizontal bars.

3.2.4.7 Brick Veneer

Provide a continuous cavity as indicated. Install brick veneer after sheathing, masonry anchors, and flashing have been installed to the cold-formed steel framing system. Care shall be provided to avoid damaging the moisture barrier. Damaged moisture barrier and flashing shall be repaired or replaced before brick veneer is installed. Means shall be provided to keep cavities clean and clear of mortar droppings.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

TOLERANCES

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural

units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

3.2.8.2 Prefaced Concrete Masonry Units

Prefaced concrete masonry units shall have a joint width of 3/8 inch wide on unfaced side and not less than 3/16 inch nor more than 1/4 inch wide on prefaced side.

3.2.8.3 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.12 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 4 inch nominal thick units shall be tied to intersecting partitions of 4 inch units, 5 inches into partitions of 6 inch units, and 7 inches into partitions of 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 4 inches of coarse aggregate or 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated on drawings. Weep holes shall be open head joints, clear round holes not less than 1/4 inch in diameter at 24 inches o.c. Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Weep holes shall be formed by placing short lengths of well-greased No. 10, 5/16 inch nominal diameter, braided cotton sash cord in the mortar and withdrawing the cords after the wall has been completed. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. Facing shall be anchored to concrete backing with wire dovetail anchors set in slots built in the face of the concrete as specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 30 00 CAST-IN-PLACE CONCRETE. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 16 inches on center vertically and 24 inches on center horizontally. Unit ties shall be spaced not over 24 inches on centers horizontally, in courses not over 16 inches apart vertically, staggered in alternate courses. Ties shall be laid not closer than 5/8 inch to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2.5 hours after mixing shall be discarded.

3.7 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.7.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.7.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.8 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches.

Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

3.9 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.9.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.9.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.9.3 Grout Holes and Cleanouts

3.9.3.1 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.3.2 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.4 Grouting Equipment

3.9.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.9.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.9.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.9.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.9.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being

immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:

a) The required minimum dimensions of total clear areas given in the table above;

b) The width of any mortar projections within the space;

c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the

distance between horizontal bond beams.

3.10 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.11 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using mortar to fill the head joint, special control-joint units, sash jamb units with control joint key, open end stretcher units in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07 92 00 JOINT SEALANTS. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.12 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.13 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 10 feet and installed with a 1/4 inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4 feet, unless limited by wall configuration.

3.14 LINTELS

3.14.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.14.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

3.15 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.16 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.16.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 16 inches on centers vertically and 24 inches on center horizontally.

3.16.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

3.17 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.18 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.19 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.19.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.19.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 1/2 cup trisodium phosphate and 1/2 cup laundry detergent to one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.20 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 30 00 CAST-IN-PLACE CONCRETE.

3.21 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.22 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

3.23 TEST REPORTS

3.23.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.23.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

3.23.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

3.23.4 Prism Tests

At least one prism test sample shall be made for each 5,000 square feet of wall but not less than three such samples shall be made for any building. Three prisms shall be used in each sample. Prisms shall be tested in accordance with ACI 530.1. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. Compressive strength shall not be less than _____ psi at 28 days. If the compressive strength of any prism falls below the specified value by more than 500 psi, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 500 psi below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results shall be permitted.

3.24 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS and Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

SECTION 04 21 13.13

NONBEARING MASONRY VENEER/STEEL STUD WALLS

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2005) Manual of Steel Construction

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-971-Spec	(1996; Supp 2001) Specification and Commentary for the Design of Cold-Formed Steel Structural Members and Commentary; includes SG-2000-1 Supp 1 to 1996 Spec, dated 2000

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP	(2005) Fundamentals Handbook, I-P Edition

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3/D1.3M	(2008) Structural Welding Code - Sheet Steel

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA PS 1	(1995) Voluntary Product Standard for Construction and Industrial Plywood

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by

	the Hot-Dip Process
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 1002	(2007) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C 1072	(2006) Standard Test Method for Measurement of Masonry Flexural Bond Strength
ASTM C 1177/C 1177M	(2006) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1396/C 1396M	(2006a) Standard Specification for Gypsum Board
ASTM C 216	(2007a) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(2007a) Standard Specification for Mortar for Unit Masonry
ASTM C 494/C 494M	(2005a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2007) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 665	(2006) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 67	(2007a) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 744	(2005) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(2007a) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 90	(2006b) Loadbearing Concrete Masonry Units
ASTM C 91	(2005) Masonry Cement
ASTM C 954	(2007) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm)

	in Thickness
ASTM C 955	(2007) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1330	(2004) Rubber Sheet Gaskets
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 2103	(2005) Standard Specification for Polyethylene Film and Sheeting
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Detail drawings as specified.

SD-04 Samples

Expansion Joint Materials
Clay or Shale Brick
Concrete Masonry Unit
Prefaced Concrete Masonry Unit
Sample Panel

A portable panel, approximately 2 by 2 feet, containing approximately 24 brick facings, 24 concrete masonry units to establish the range of color and texture. One of each type of masonry veneer anchor used.

SD-06 Test Reports

Calculations

Calculations demonstrating the structural adequacy of steel lintels and shelf angles for the calculated gravity loads being supported; this analysis shall be in accordance with AISC 325. Test results demonstrating that the veneer anchors are structurally adequate to resist the specified loadings shall be submitted for approval. Calculations demonstrating the insulation shown on the drawings provides the specified U-value for heat

transmission of the completed exterior wall construction; this analysis shall be in accordance with ASHRAE FUN IP. Manufacturer's descriptive data and installation instructions for the insulation, the vapor barrier and the moisture barrier.

SD-07 Certificates

Clay or Shale Brick
Concrete Masonry Unit
Joint Reinforcement
Expansion Joint Materials
Insulation
Exterior Sheathing
Moisture Barrier
Vapor Retarder
Veneer Anchors
Welding

Certificates stating that the materials and welders meet the requirements specified. Each certificate shall be signed by an authorized certification official and shall include their organization and position and shall identify the products covered under their certifying signature.

1.3 SAMPLE PANEL

After the material samples are approved and prior to starting masonry work, a sample masonry panel shall be built on the project site where directed. The sample panel shall be not less than 6 feet long by 4 feet high. The panel shall be of typical wall thickness for the construction represented. The panel shall show color range, texture, bond pattern, expansion joints, and cleaning of the masonry as required in the work. The panel shall also show cold-formed steel framing, insulation, gypsum wallboard, gypsum sheathing, moisture barrier, vapor barrier, veneer anchors, joint reinforcement, steel shelf angles, flashing and weep holes. The approved sample panel shall be used as a standard of workmanship required in the actual installation. The sample panel shall be protected from weather and construction operations and shall not be removed until the masonry veneer/steel stud wall work has been completed and accepted.

1.4 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered and handled avoiding chipping, breakage, bending or other damage, and contact with soil or other contaminating materials. The masonry products shall be stored off the ground and protected from inclement weather. Cementitious materials shall be delivered in unopened containers plainly marked and labeled with manufacturer's names and brands. Cementitious materials shall be stored in dry, weather-tight enclosures or covers. Sand and other aggregates shall be stored preventing contamination or segregation and under a weather-tight covering permitting good air circulation. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content galvanizing repair paint whenever necessary to prevent the formation of rust. Insulation, moisture barrier, and gypsum sheathing shall be stored in dry, well ventilated, weather-tight areas protected from sunlight and excessive heat. Air infiltration type vapor barrier shall be stored in accordance with the manufacturer's recommendations.

1.5 EFFLORESCENCE TESTS

Efflorescence tests shall be performed by an approved commercial testing laboratory. Sampling for the tests shall be the responsibility of the Contractor. Brick shall be sampled and tested for efflorescence in accordance with ASTM C 67 and the rating shall be: "not effloresced".

1.6 DETAIL DRAWINGS

The Contractor shall submit details of cold-formed steel framing and support around openings, including framing connections, steel lintels, steel shelf angles, attachment to other building elements and bridging. Drawings shall indicate thickness, material, dimensions, protective coatings, and section properties of all steel lintels and shelf angles used in exterior wall framing. Drawings shall also indicate size and type of all fasteners including size and type of all welds.

PART 2 PRODUCTS

2.1 VENEER WYTHE

The source of masonry materials which will affect the appearance of the finished work shall not be changed after the work has started except with the Contracting Officer's approval.

2.1.1 Clay or Shale Brick

Clay or shale brick veneer shall be masonry units conforming to ASTM C 216, Type FBS. Color range and texture shall be as indicated and shall conform to the approved sample. Grade SW shall be used for all brickwork. Brick unit sizes shall be modular, as shown.

2.1.2 Concrete Masonry Unit

Concrete masonry unit veneer shall be solid and conform to ASTM C 90. Architectural type, color range and texture shall be as indicated and shall conform to the approved sample. Masonry unit sizes shall be modular, as shown.

2.1.3 Prefaced Concrete Masonry Unit

Prefaced concrete masonry unit veneer shall conform to ASTM C 744 using masonry units conforming to ASTM C 90. Prefaced concrete unit facing shall turn over the edges and ends of the unit at least 3/8 inch in the direction of the thickness of the unit to form a lip at least 1/16 inch thick. Variation in color and texture shall not exceed that of the approved samples. Masonry unit sizes shall be modular, as shown.

2.2 MORTAR

Mortar shall conform to ASTM C 270, Type S. Mortar mix shall be based on proportion specifications. Laboratory testing of mortar shall be in accordance with the preconstruction evaluation of mortar section of ASTM C 780. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.2.1 Masonry Cement

Masonry cement in conformance with ASTM C 91 may be used in the mortar.

When using a masonry cement a comparative test shall be performed between a Portland cement-lime mortar and the masonry cement mortar proposed for the project to evaluate the ASTM C 1072 bond and the ASTM C 780 compressive strength of the two mixes. The test shall be conducted with the proposed masonry units for the project. The masonry cement mortar will be acceptable if the bond and compressive strength values are equal to or higher than the portland cement-lime mix. The air-content of the masonry cement shall be limited to 12 percent maximum.

2.2.2 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixtures shall be non-corrosive, contain less than 0.2 percent chlorides, and conform to ASTM C 494/C 494M, Type C.

2.3 JOINT REINFORCEMENT

Joint reinforcement shall be of steel wire conforming to ASTM A 82/A 82M. Fabrication shall be by welding. Tack welding will not be permitted. Reinforcement shall be zinc-coated after fabrication in accordance with ASTM A 153/A 153M, Class B-2. Joint reinforcement shall consist of at least 1 continuous longitudinal wire in the veneer wythe. Minimum wire cross section shall be 0.017 square inches.

2.4 COLD-FORMED STEEL FRAMING

Cold-formed framing shall consist of steel studs, top and bottom tracks, runners, horizontal bridging, and other cold-formed members and other accessories. All members and components made of sheet steel shall be hot-dip galvanized in accordance with ASTM A 653/A 653M with a minimum coating thickness of G 60. Framing covered herein shall be used only in framing the exterior masonry veneer steel stud wall system as indicated on the detail drawings. Metal framing for interior partitions are specified in Section 09 22 00 METAL SUPPORT ASSEMBLIES. Metal framing for _____ is specified in Section _____.

2.4.1 Steel Studs

Studs shall be furnished as shown in the contract drawings.

2.4.2 Runners, Tracks, Bridging and Accessories

Cold-formed steel sheet framing members, components, and accessories, other than the steel studs, shall conform to ASTM C 955 and be of steel conforming to ASTM A 653/A 653M, Grade 33, having a minimum yield strength of 33,000 psi.

2.5 INSULATION

The Contractor shall comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.5.1 Blanket Insulation

Insulation placed between the steel studs shall be batt or blanket type mineral wool conforming to ASTM C 665, Type I, II, III.

2.5.2 Rigid Board-Type Insulation

Insulation for wall cavities shall be rigid board-type insulation. Rigid board-type insulation shall be either polystyrene conforming to ASTM C 578, Type I or II, Grade 2 or polyurethane conforming to ASTM C 591. Insulation thickness shall be sufficient to provide an R-value of _____.

2.6 GYPSUM WALLBOARD

Gypsum wallboard that is installed on the interior side of the cold-formed steel framing system shall be as specified in Section 09 29 00 GYPSUM BOARD.

2.7 EXTERIOR SHEATHING

Gypsum, Plywood sheathing that is installed on the exterior side of the cold-formed steel framing system shall have a minimum thickness of 1/2 inch and shall be 4 feet wide. Glass mat gypsum sheathing shall conform to ASTM C 1396/C 1396M and ASTM C 1177/C 1177M. Glass mat gypsum sheathing shall have a water-resistant core with a water-resistant glass mat embedded onto core and shall have a zero flame, zero smoke developed, and shall have mold and mildew resistant surface. Gypsum sheathing shall conform to ASTM C 1396/C 1396M. Gypsum sheathing shall have a water-resistant gypsum core with a water-repellent paper firmly bonded to the core. Plywood sheathing shall be in accordance with APA PS 1, grade C-D with exterior glue.

2.8 MOISTURE PROTECTION

2.8.1 Moisture Barrier

The moisture barrier shall be 15-lb asphalt-saturated felt conforming to ASTM D 226 Type I (No. 15).

2.8.2 Vapor Retarder

The vapor retarder shall be polyethylene film conforming to ASTM D 2103, 6 mil minimum thickness.

2.8.3 Staples

Staples for attaching the moisture barrier to the exterior sheathing shall be the type and size best suited to provide a secure connection. Staples shall be made from either galvanized steel or stainless steel wire.

2.8.4 Joint Tape

Tape for sealing the joints in the vapor retarder shall be laminated tape with pressure sensitive adhesive as recommended by the manufacturer of the polyethylene film.

2.9 VENEER ANCHORS

Anchor assemblies for the attachment of the masonry veneer to the cold-formed steel framing, structural steel and/or concrete beam and column members, and concrete floor slabs shall be as shown, shall be designed for the design loadings shown. Anchors shall transfer the design loadings from the masonry veneer to the cold-formed steel framing system or other support without exceeding the allowable stresses and deflections in the anchors. Length of anchor wires shall be such that the outermost wires lie between

1-1/4 inch from each face of the masonry veneer. Anchors wires shall not have drips. Wires for veneer anchors shall be rectangular or triangular hoops formed from 3/16 inch diameter steel wire conforming to ASTM A 82/A 82M. Anchor assemblies including wires and anchor plates shall be hot-dip galvanized conforming to ASTM A 153/A 153M, Class B-2. The veneer anchor shall have a minimum capacity of 200 pounds. The load-displacement capacity of each veneer anchor, both in direct pull-out for tension and compression, shall be not less than 2000 pounds/inch (or a deflection of 0.05 inches/100 pounds of load in tension or compression). In the direction perpendicular to the masonry veneer, the anchor assembly shall have a maximum play of 1/16 inch.

2.9.1 Adjustable Pintle-Eye Type Wire Anchors

Adjustable pintle-eye type wall anchors shall be two pieces rectangular type double pintle anchors.

2.9.2 Dovetail Anchors

Dovetail slots are specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 30 00 CAST-IN-PLACE CONCRETE.

2.10 CONNECTIONS

Screws, bolts and anchors shall be hot-dip galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate.

2.10.1 Framing Screws, Bolts and Anchors

Screws, bolts and anchors used in the assembly of the cold-formed steel framing system shall be as shown, as required by design of the framing system for the specified loading. Screw, bolt and anchor sizes shall be shown on the detail drawings.

2.10.2 Welding

Welded connections shall be designed and all welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI SG-971-Spec. Welders shall be qualified in accordance with AWS D1.3/D1.3M. All welds shall be cleaned and touched-up with zinc-rich paint.

2.10.3 Veneer Anchor Screws

Screws for attachment of the veneer anchors to the cold-formed steel framing members shall be No. 12, as shown, as required by design to provide the needed pullout load capacity but not less than No. 12. Screws shall be shown on the detail drawings. The length of screws shall be such that the screws penetrate the holding member by not less than 5/8 inch.

2.10.4 Gypsum Sheathing Screws

Screws for attachment of gypsum sheathing to cold-formed steel framing shall conform to ASTM C 1002, Type S, ASTM C 954.

2.11 SYNTHETIC RUBBER WASHERS

Synthetic rubber washers for placement between veneer anchors and the moisture barrier on the outside face of the exterior sheathing shall conform to ASTM D 1330, Grade I.

2.12 EXPANSION JOINT MATERIALS

Expansion joint materials shall be bellows or U-shaped type conforming to Section 07 57 13 FLASHING AND SHEET METAL. Premolded type shall be closed-cell cellular rubber conforming to ASTM D 1056 or closed-cell vinyl or polyvinyl chloride conforming to ASTM D 1667.

2.13 FLASHING

Copper or stainless steel flashing shall conform to the requirements in Section 07 57 13 FLASHING AND SHEET METAL. Flashing shall be supplied in a continuous sheet extending from the exterior sheathing across the cavity and through the masonry veneer as shown.

2.14 STEEL LINTELS AND SHELF ANGLES

Steel shapes used for lintels and shelf angles shall conform to ASTM A 36/A 36M. Lintels and shelf angles shall be provided as shown. These steel members shall be hot-dip galvanized in accordance with ASTM A 123/A 123M.

2.15 CAULKING AND SEALANTS

Caulking and sealants shall be as specified in Section 07 92 00 JOINT SEALANTS.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Wall sections, types of construction and dimensions shall be as shown. Metal door and window frames and other special framing shall be built and anchored into the wall system as indicated. The Contractor shall submit Calculations as specified in the Submittals paragraph.

3.2 STEEL STUD WALL FRAMING

The top track of the stud wall system shall be slip jointed to accommodate vertical deflections of the supporting members as shown on the drawings. Top and bottom tracks shall be securely anchored to resist track rotation by alternating fastener locations to provide two rows, one row near each track flange as shown on the drawings. Top and bottom tracks shall be anchored by one anchor at each stud location as shown on the drawings. Both flanges of all steel studs shall be securely fastened with screws to the flanges of the top and bottom tracks as shown on the drawings. All details for affixing steel studs to runners and all other sheet steel framing members along with all details necessary for anchorage of the steel stud wall system to the building structural systems shall be as shown on the drawings. Horizontal bridging shall be provided as necessary. Studs shall be spaced 16 inches on center, 24 inches on center,nas indicated on the drawings, as required to resist the specified design wind or seismic loadings, but not exceeding 24 inches on center. Coordinate stud spacing with sheathing and anchor requirements. At wall openings for doors, windows and other similar features, the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Steel frames shall be securely attached through built-in anchors to the nearest stud on each side of the opening with self-drilling screws. Double studs shall be provided at both jambs of all door openings. Door frames

and other built-in items shall be spot grouted at the jamb anchor locations, grouted solid.

3.3 STEEL SHELF ANGLES

Unless otherwise shown, steel shelf angles shall be provided in segments that do not exceed 10 feet in length. At building corners, shelf angle segments shall be mitered and securely attached together by welding with legs no less than 4 feet where possible. Shelf angle segments shall not be connected together but instead shall be installed with 1/4 inch wide gaps between the segments. Fabrication and erection tolerances shall be in accordance with the AISC Code of Standard Practice, as indicated in AISC 325.

3.4 INSULATION

The actual installed thickness of insulation shall provide a maximum thermal R of _____ for the completed exterior wall construction as determined in accordance with ASHRAE FUN IP. Insulation thickness shall be as shown on the approved drawings. Installation, except as otherwise specified or shown, shall be in accordance with the manufacturer's instructions which shall be approved by the Contracting Officer. Insulation shall be installed between wall framing members. Rigid insulation shall be installed in accordance with the manufacturer's instructions with proper connections through the insulation to prevent the insulation from carrying loads directly. Insulation with facings shall be secured to the sides of the framing members to provide a continuous seal so that the entire weight of the insulation is carried by the framing members. Where electrical outlets, ducts, pipes, vents or other utility items occur, insulation shall be placed on the dry side of the item away from excessive humidity.

3.5 GYPSUM WALLBOARD

Gypsum wallboard shall be installed on the interior face of the cold-formed steel framing system. Installation shall be as specified in Section 09 29 00 GYPSUM BOARD except at vertical slip joints, the gypsum wallboard shall be connected to the vertical studs to prevent movement at the slip joint.

3.6 EXTERIOR SHEATHING

Sheathing shall be installed on the exterior face of the cold-formed steel framing system with self-drilling screws. Screws shall be located a minimum of 3/8 inch from the ends and edges of sheathing panels and shall be spaced not more than 8 inches on each supporting member except at vertical slip joints, the sheathing shall be connected to the vertical studs to prevent movement of the slip joint. Edges and ends of gypsum sheathing panels shall be butted snugly with vertical joints staggered to provide full and even support for the moisture barrier. Holes and gaps resulting from abandoned screw installations, from damage to panels, and from cutting and fitting of panels at junctures with doors, windows, foundation walls, floor slabs and other similar locations shall be filled with exterior rubber-base caulk.

3.7 MOISTURE PROTECTION

3.7.1 Moisture Barrier

The asphalt-saturated felt or other approved moisture barrier shall be

installed on the outer face of the exterior sheathing. The moisture barrier shall be installed horizontally and shingled with each sheet lapped not less than 6 inches over the sheet below. Vertical end joints shall be lapped not less than 6 inches and shall be staggered. Attachment of the moisture barrier shall be with staples spaced not greater than 16 inches on center or as required by the manufacturer.

3.7.2 Vapor Retarder

A vapor retarder shall be installed between the steel studs and the gypsum wall board, between the steel studs and the exterior sheathing. The vapor retarder shall be installed in accordance with the manufacturer's recommendations to form a complete retarder to vapor infiltration. The joints shall be lapped and sealed with tape.

3.8 VENEER ANCHORS

Veneer anchors shall be attached with screws through the sheathing and rigid insulation to the steel studs or other support members at the locations shown. When rigid insulation is used, the method of connecting the veneer anchor through the insulation shall be approved by the Contracting Officer. Veneer anchors shall be installed with the outermost wires lying between 5/8 inch from each face of the masonry veneer. Synthetic rubber washers shall be used between the anchor connector plates and the moisture barrier. A clutch torque slip screw gun shall be used on screws attaching veneer anchors to cold-formed steel members. Veneer anchors with corrugated sheet metal or wire mesh members extending across the wall cavity shall not be used. There shall be one veneer anchor for each two square feet of wall and shall be attached to steel studs and other supports with a maximum spacing of 24 inches on center. For pintle-eye anchors the vertical distance between the pintle section horizontal wires and the eye section horizontal wires shall not exceed 1/2 inch. Dovetail slots shall be installed as specified in the Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETEm 03 30 00 CAST-IN-PLACE CONCRETE.

3.9 FLASHING

Continuous flashing shall be provided at the bottom of the wall cavity just above grade. Flashing shall also be provided above and below openings at lintels and sills, at shelf angles, and as indicated on the drawings. Flashing shall be as detailed and as specified in Section 07 57 13 FLASHING AND SHEET METAL. Flashing shall be lapped a minimum of 6 inches at joints and shall be sealed with a mastic as recommended by the flashing manufacturer. Ends over doors, windows and openings shall be turned up and secured. Flashing shall be lapped under the moisture barrier a minimum of 6 inches and securely attached to the gypsum sheathing. Flashing shall extend through the exterior face of the masonry veneer and shall be turned down to form a drip.

3.10 MASONRY VENEER

Exterior masonry wythes shall be constructed to the thickness indicated on the drawings. A cavity consisting of a 2 inch minimum width air space will be provided between the moisture barrier and the masonry veneer. Masonry veneer shall not be installed until the exterior sheathing, moisture barrier, veneer anchors and flashing have been installed on the cold-formed steel framing system. Extreme care shall be taken to avoid damage to the moisture barrier and flashing during construction of the masonry veneer. Any portion of the moisture barrier and flashing that is damaged shall be

repaired or replaced prior to completion of the veneer. Masonry shall be placed in running bond pattern, shall be placed in stacked bond pattern. Longitudinal reinforcement consisting of at least one continuous galvanized steel wire shall be placed in the veneer wythe. The minimum wire size shall be 9 gauge, bond pattern shall be as indicated on the drawings. Vertical joints on alternating courses shall be aligned and kept vertically plumb. Solid masonry units shall be laid in a non-furrowed full bed of mortar, beveled and sloped toward the center of the wythe on which the mortar is placed. Units shall be shoved into place so that the vertical mortar joints are completely full and tight. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned and relaid. Mortar which protrudes more than 1/2 inch into the cavity space shall be removed. Means shall be provided to ensure that the cavity space is kept clean of mortar droppings and other loose debris. Chases and raked-out joints shall be kept free from mortar and debris. Faces of units used in finished exposed areas shall be free from chipped edges, material texture or color defects or other imperfections distracting from the appearance of the finished work.

3.10.1 Surface Preparation

Surfaces on which masonry is to be laid shall be cleaned of laitance or other foreign material. No units having a film of water shall be laid.

3.10.2 Hot Weather Construction

Temperatures of masonry units and mortar shall not be greater than 120 degrees F when laid. Masonry erected when the ambient air temperature is more than 99 degrees F in the shade and when the relative humidity is less than 50 percent shall be given protection from the direct exposure to wind and sun for 48 hours after the installation.

3.10.3 Cold Weather Construction

Temperatures of masonry units and mortar shall not be less than 40 degrees F when laid. When the ambient air temperature is 32 degrees F or less, masonry veneer under construction shall be protected and maintained at a temperature greater than 32 degrees F for a period of 48 hours after installation. The proposed method of maintaining the temperature within the specified range shall be submitted for approval prior to implementation. No units shall be laid on a surface having a film of frost or water.

3.10.4 Tolerances

Masonry shall be laid plumb, level and true to line within the tolerances specified in TABLE 1. All masonry corners shall be square unless otherwise indicated on the drawings.

TABLE 1

Variation From Plumb	
In adjacent units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variation From Level Or Grades	
In 10 feet	1/8 inch
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation From Linear Building Lines	
In 20 feet	1/2 inch
In 40 feet or more	3/4 inch

Variation From Cross Sectional Dimensions Of Walls	
Plus	1/2 inch
Minus	1/4 inch

3.10.5 Mixing of Mortar

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Measurement of sand shall be accomplished by the use of a container of known capacity or shovel count based on a container of known capacity. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of the masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours shall be discarded.

3.10.6 Cutting and Fitting

Wherever possible, full units shall be used in lieu of cut units. Where cut units are required to accommodate the design, cutting shall be done by masonry mechanics using power masonry saws. Wet-cut units shall be dried to the same surface-dry appearances of uncut units before being placed in the work. Cut edges shall be clean, true and sharp. Openings to accommodate pipes, conduits, and other accessories shall be neatly formed so that framing or escutcheons required will completely conceal the cut edges. Insofar as practicable, all cutting and fitting shall be accomplished while masonry work is being erected.

3.10.7 Masonry Units

When being laid, masonry units shall have suction sufficient to hold the mortar and to absorb water from the mortar, but shall be damp enough to allow the mortar to remain in a plastic state to permit the unit to be leveled and plumbed immediately after being laid without destroying bond. Masonry units with frogging shall be laid with the frog side down and better or face side exposed to view. Masonry units that are cored, recessed or otherwise deformed may be used in sills or in other areas except where deformations will be exposed to view.

3.10.8 Mortar Joints

Mortar joint widths shall be uniform and such that the specified widths are maintained throughout. Joints shall be of thickness equal to the difference between the actual and nominal dimensions of the masonry units in either height or length but in no case shall the joints be less than 1/4 inch nor more than 1/2 inch wide. Joints shall be tooled slightly concave. Tooling shall be accomplished when mortar is thumbprint hard and in a manner that will compress and seal the mortar joint and produce joints of straight and true lines free of tool marks.

3.10.9 Joint Reinforcement

Unless otherwise shown, joint reinforcement shall be spaced at 16 inches on center vertically. Joint reinforcement shall not be placed in the same masonry course as veneer anchors unless the anchors are designed to accommodate the wire. Joint reinforcement shall be placed so that longitudinal wires are centered in the veneer wythe for solid units. Longitudinal wires shall be fully embedded in mortar for their entire length. Splices in joint reinforcement shall be lapped a minimum of 6 inches. Joint reinforcement must be discontinuous at all veneer joints. The minimum cover for joint reinforcement is 5/8 inches.

3.10.10 Veneer Joints

Brick expansion joints and concrete masonry veneer joints shall be provided at the locations shown on the drawings. Details of joints shall be as indicated on the drawings. Joints shall be clean and free of mortar and shall contain only backer rod and sealant, installed in accordance with Section 07 92 00 JOINT SEALANTS. Horizontal reinforcement shall not extend through the joints.

3.10.11 Weep Holes

Weep holes shall be provided at all flashing locations at intervals of 24, 16 inches. Weep holes shall be placed in head joints just above the flashing. Weep holes shall be formed by leaving head joints open or head joint vents may be used. Weep holes shall be kept free of mortar and other obstructions.

3.10.12 Head Joint Vents

Head joint vents shall be provided near the top of the veneer wythe at the same spacing as the weep holes.

3.10.13 Discontinuous Work

When necessary to temporarily discontinue the work, masonry shall be stepped back for joining when work resumes. Toothing may be used only when specifically approved. Before resuming work, loose mortar shall be removed and the exposed joint shall be thoroughly cleaned. Top of walls subjected to rain or snow shall be covered with nonstaining waterproof covering or membrane when work is not in process. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place.

3.10.14 Cleaning

Mortar daubs or splashings shall be completely removed from finished exposed masonry surfaces before they harden or set up. Before completion

of the work, defects in mortar joints shall be raked out as necessary, filled with mortar, and tooled to match the adjacent existing mortar in the joints. The proposed cleaning method shall be done on the sample wall panel and the sample panel shall be examined for discoloration or stain. If the sample panel is discolored or stained, the method of cleaning shall be changed to ensure that the masonry surfaces in the structure will not be adversely affected. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Cleaning shall be accomplished with the use of stiff bristle fiber brushes, wooden paddles, wooden scrapers, or other suitable nonmetallic tools. The exposed brick surfaces shall be saturated with water and cleaned with a proprietary brick cleaning agent recommended by the clay products manufacturer. The cleaning agent shall not adversely affect the brick masonry surfaces. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Concrete masonry unit surfaces shall be dry-brushed at the end of each day's work after any required pointing has been done. Efflorescence or other stains shall be removed in conformance with the recommendations of the masonry unit manufacturer. After construction and cleaning, masonry surfaces shall be left clean, free of mortar daubs, stain, and discolorations, including scum from cleaning operations, and will have tight mortar joints throughout. Metallic tools and brushes shall not be used for cleaning.

3.11 BUILDING EXPANSION JOINTS

Expansion joints shall be located where indicated and shall be of the size and details shown.

-- End of Section --

SECTION 05 05 23

WELDING, STRUCTURAL

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(2001) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2007) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	(2001) Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting and Thermal Spraying
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2008) Structural Welding Code - Sheet Steel
AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel
AWS D14.1/D14.1M	(2005) Welding Industrial and Mill Cranes and Other Material Handling Equipment
AWS D14.4/D14.4M	(2005) Welded Joints for Machinery and Equipment
AWS Z49.1	(2005) Safety in Welding, Cutting and Allied Processes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 165	(2002) Standard Test Method for Liquid Penetrant Examination
ASTM E 709	(2001) Standard Guide for Magnetic

Particle Examination

1.2 DEFINITIONS

Definitions of welding terms are in accordance with AWS A3.0. The following classifications Class 1 (highest class) to Class 6 (lowest class), indicate the project's class(es) of weld joints.

1.2.1 Class 1 Weld Joints

This covers complete penetration weld joints only. These weld joints apply where failure would cause a loss of the system and/or be hazardous to personnel. Class 1 weld joints are highly stressed (dynamic and cyclic loading) and characterized as a single point of failure with no redundancy for the redistribution of stress into another member.

1.2.2 Class 2 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would reduce the overall efficiency of a system but loss of the system or a hazard to personnel would not be experienced.

1.2.3 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.2.4 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.2.5 Class 5 Weld Joints

This covers weld joints applicable to welding concrete reinforcing steel splices (prestressing steel excepted), steel connection devices, and inserts and anchors required in concrete construction.

1.2.6 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.3 GENERAL REQUIREMENTS

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in

welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.3.2 Mock-up Model

Perform first the field-welded connection designated as the mock-up model on the drawings. All welders qualified and designated to perform field-welded groove joints must be present during the welding of the mock-up model connections and each one shall perform a part of the welding. Simulate with the mock-up test all physical and environmental conditions that will be encountered during the welding of all groove joints. Execute all inspection procedures required for groove welded joints, including NDE tests, on the mock-up model. All Contractor inspection and testing personnel designated to perform QC of groove welded joints must be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection represents the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding Procedure Qualifications
Welder, Welding Operator, and Tacker Qualification
Inspector Qualification
Previous Qualifications
Pre-qualified Procedures

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control
Nondestructive Examination

A quality assurance plan and records of tests and inspections.

Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

SD-07 Certificates

Certified Welding Procedure Specifications (WPS)
Certified Brazing Procedure Specifications (BPS)
Certified Procedure Qualification Records (PQR)
Certified Welder Performance Qualifications (WPQ)
Certified Brazer Performance Qualifications (BPQ)

Certificates in accordance with paragraph "Other Applications".

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for pre-qualified (per AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform qualification of welding procedures to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Appendix E of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 General Requirements

The organization performing this work must be certified in the following: American Institute of Steel Construction (AISC) Quality Certification Program Category Category I Conventional Steel Structures, Category II Complex Steel Building Structures, Category III Major Steel Bridges.

a. For Structural Projects, provide documentation of the following:

1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.

3) Reinforcing Steel: Qualification documents (WPS, PWR, and WPQ) in accordance with AWS D1.4/D1.4M.

b. For other applications, provide documentation of the following:

1) Submit for approval to the Contracting Officer two copies of Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) within fifteen calendar days after receipt of Notice to Proceed.

2) Cranes: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.1/D14.1M.

3) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.5.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints. No pre-qualified welding procedures are allowed. Contractor shall qualify the welding procedures and welders by tests prescribed in the applicable code or specification not withstanding the fact the code or specification may allow pre-qualified procedures.

1.5.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, the procedure specification must be revised and re-qualified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, must be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract must be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification must state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.6.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspector qualifications must be in accordance with AWS D1.1/D1.1M. Qualify all nondestructive testing personnel in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols must be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safe weldiing practices and safety precautions during welding must conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes must be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual and radiographic, ultrasonic, magnetic particle, and liquid penetrant dye penetrant inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E 165, ASTM E 709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection and radiographic, ultrasonic, magnetic particle, or dye penetrant methods. The minimum extent of nondestructive testing must be random _____ percent of welds or joints, as indicated on the drawings.

3.3.1 Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2005) Code of Standard Practice for Steel Buildings and Bridges
AISC 317	(1992; Reprint 1999) ASD Manual of Steel Construction, Vol II: Connections
AISC 325	(2005) Manual of Steel Construction
AISC 326	(2002) Detailing for Steel Construction
AISC 341	(2005; Supp 2001) Seismic Provisions for Structural Steel Buildings
AISC 348	(2000) Structural Joints Using ASTM A325 or A490 Bolts
AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary
AISC 810	(1997) Erection Bracing of Low-Rise Structural Steel Frames/Fisher and West
AISC FCD	(1995a) Quality Certification Program Description

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2007) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(2002) Surface Texture (Surface Roughness, Waviness and Lay)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 108	(2007) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 143/A 143M	(2007) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 242/A 242M	(2004e1) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 276	(2006) Standard Specification for Stainless Steel Bars and Shapes
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2007a) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2007) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 490	(2006) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 500/A 500M	(2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(2005) Standard Specification for High-Yield-Strength, Quenched and Tempered

	Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(2005) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 572/A 572M	(2007) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(2005) Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A 6/A 6M	(2007) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 618/A 618M	(2004) Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 668/A 668M	(2004) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 709/A 709M	(2007) Standard Specification for Structural Steel for Bridges
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 852/A 852M	(2003; R 2007) Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM A 992/A 992M	(2006a) Standard Specification for Structural Steel Shapes
ASTM B 695	(2004) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C 1107/C 1107M	(2007a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 827	(2001a; R 2005) Change in Height at Early Ages of Cylindrical Specimens from

	Cementitious Mixtures
ASTM F 436	(2007a) Hardened Steel Washers
ASTM F 844	(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(2007a) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting
SSPC PS 13.01	(1982; E 2004) Epoxy-Polyamide Painting System
SSPC Paint 25	(1997; E 2004) Paint Specification No. 25Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel Type I and Type II
SSPC SP 3	(2004; E 2004) Power Tool Cleaning
SSPC SP 6	(2000; E 2004) Commercial Blast Cleaning

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer, galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 325 and AISC 317 except as modified in this contract.

1.3 MODIFICATIONS TO REFERENCES

Conform to AISC 325, AISC 317, AISC 360, AISC 303, AISC 348, and AISC 325, except as modified in this section.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection Plan, including description of temporary supports

Fabrication drawings including description of connections

SD-03 Product Data

Shop primer

Welding electrodes and rods

Load indicator washers

Non-Shrink Grout

Load indicator bolts

Include test report for Class B primer.

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

Pins and rollers

AISC Quality Certification

Overhead, top running crane rail beam

Welding procedures and qualifications

1.5 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category Sbd fabrication plant.

1.6 SEISMIC PROVISIONS

The structural steel system shall be provided in accordance with AISC 341.

1.7 QUALITY ASSURANCE

1.7.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326, AISC 325 and AISC 317. Fabrication drawings shall not be reproductions of contract drawings. Sign and seal fabrication drawings by a professional engineer registered in the State where the project is located. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.7.2 Certifications

1.7.2.1 Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance requirements, area out of tolerance and proposed corrective measures.

1.7.2.2 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.7.2.3 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A 36/A 36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

ASTM A 572/A 572M. ASTM A 992/A 992M , ASTM A 709/A 709M.

2.1.2.2 Quenched and Tempered Alloy Steel

ASTM A 514/A 514M.

2.1.2.3 Quenched and Tempered Low-Alloy Steel

ASTM A 852/A 852M, 70 ksi.

2.1.3 Weathering Structural Steel

ASTM A 242/A 242M, Type 1; ASTM A 588/A 588M.

2.1.4 Structural Grade Carbon-Manganese Steel

ASTM A 529/A 529M, high strength carbon-manganese steel of structural quality.

2.1.5 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A 992/A 992M.

2.1.6 Structural Steel Tubing

ASTM A 500/A 500M, Grade B; ASTM A 501; ASTM A 618/A 618M.

2.1.7 Steel Pipe

ASTM A 53/A 53M, Type E or S, Grade B, weight class STD (Standard).

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel , Steel Pipe

2.2.1.1 Bolts

ASTM A 307, Grade A; ASTM A 325, Type 1, ASTM A 490, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A 563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 and ASTM A 490 bolts.

2.2.2 High-Strength Structural Steel

2.2.2.1 Bolts

ASTM A 325, Type 1 ASTM A 490, Type 1 or 2.

2.2.2.2 Nuts

ASTM A 563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F 436, plain carbon steel.

2.2.3 Weathering Structural Steel

2.2.3.1 Bolts

ASTM A 325, Type 3; ASTM A 490, Type 3.

2.2.3.2 Nuts

ASTM A 563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A 325 bolts.

2.2.3.3 Washers

ASTM F 436, weathering steel.

2.2.4 Foundation Anchorage

2.2.4.1 Anchor Bolts

ASTM A 307. Type 304 conforming to ASTM A 276.

2.2.4.2 Anchor Nuts

ASTM A 563, Grade A, hex style. Type 304 conforming to ASTM A 276.

2.2.4.3 Anchor Washers

ASTM F 844. Type 304 conforming to ASTM A 276.

2.2.5 Load Indicator Washers

ASTM F 959. Provide ASTM B 695, Class 50, Type 1 galvanizing.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout

ASTM C 1107/C 1107M, with no ASTM C 827 shrinkage.

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.3.4 Pins and Rollers

ASTM A 668/A 668M, Class C, D, F, or G; ASTM A 108, Grades 1016 to 1030. Provide as specified in AASHTO HB-17, Division II, Sections 10.26 and 10.27, except provide pins in lengths to extend a minimum of 0.25 inch beyond the outside faces of the connected parts.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 325 and AISC 317 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded or on surfaces of weathering steels that will be exposed in the completed structure. Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive sprayed-on fireproofing, surfaces to receive epoxy coatings, surfaces designed as part of a composite steel concrete section, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.6.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.6.3 Fireproofing and Epoxy Coated Surfaces

Surfaces to receive sprayed-on fireproofing or epoxy coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations, and as specified in Section 07 81 00 SPRAY-APPLIED FIREPROOFING.

2.6.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

2.7 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category Supplement structural steelwork.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC FCD and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

3.2 ERECTION

a. Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC 325. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance with AISC 810.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt and pin holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

ASTM A 307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is

the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.3.2 High-Strength Bolts

ASTM A 325 and ASTM A 490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Provide load indicator washers in all ASTM A 325M or ASTM A 490 bolted connections, except provide only load indicator washers for slip critical connections. Direct tension indicator tightening, shall be the only acceptable tightening methods. Use only direct tension indicator tightening for slip critical connections. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.3.2.1 Installation of Load Indicator Washers (LIW)

ASTM F 959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F 436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F 436 washers under both the bolt head and nut when ASTM A 490 bolts are used.

3.4 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officers.

3.5 WELDING

AWS D1.1/D1.1M, except use only shielded metal arc welding and low hydrogen electrodes for ASTM A 514/A 514M steel. Do not stress relieve ASTM A 514/A 514M steel by heat treatment. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.5.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.6 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.7 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.8.1 Welds

3.8.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.8.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be as indicated. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

3.8.2 Load Indicator Washers

3.8.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the load indicator washer is placed under the turned element, as required by ASTM F 959.

3.8.2.2 Load Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, shall test in place the load indicator gapson 20 percent of the installed load indicator washers to verify that the ASTM F 959 load indicator gaps have been achieved. If more than 10 percent

of the load indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F 959, then all in place load indicator washers shall be tested to verify that the ASTM F 959 load indicator gaps have been achieved. Test locations shall be selected by the Contracting Officer.

3.8.3 High-Strength Bolts

3.8.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 348, Table 4, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.8.3.2 Inspection

Inspection procedures shall be in accordance with AISC 348, Section 9. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

Inspection by the Government will include proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use; and calibration of torque wrenches for high-strength bolts.

The Contractor shall inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use; and calibration of torque wrenches for high-strength bolts.

Inspection of high-strength bolted connections by the Government will be performed in accordance with AISC 317.

The Contractor shall inspect high-strength bolted connections in accordance with AISC 317.

3.8.4 Testing for Embrittlement

ASTM A 143/A 143M for steel products hot-dip galvanized after fabrication.

3.9 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

SECTION 05 21 19

OPEN WEB STEEL JOIST FRAMING

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS B2.1	(2005; Errata 2006; Errata 2006) Welding Procedure and Performance Qualification
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

STEEL JOIST INSTITUTE (SJI)

SJI 279167 SPECS/LOADS	(2006) 42nd Edition Standard Specifications and Load Tables for Steel Joists and Joist Girders
SJI MANUAL	(2003) 75 Year Manual, 1928-2003
SJI TD 10	(2003) Technical Digest for the Design of Fire Resistive Assemblies with Steel Joists
SJI TD 8	(1983) Technical Digest for the Welding of Open Web Steel Joists
SJI TD 9	(2006) Technical Digest for the Handling and Erection of Steel Joists and Joist Girders

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS 14.01	(1982; E 2004) Steel Joist Shop Painting System
SSPC Paint 15	(1999; R 2004) Steel Joist Shop Primer/Metal Building Primer

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1200	Hazard Communication
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.757	Steel Erection; Open Web Steel Joists

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Welder qualification

Material Safety Data Sheet (MSDS) per OSHA 1910.1200

SD-02 Shop Drawings

Steel joist framing

SD-06 Test Reports

Erection inspection

Welding inspections

SD-07 Certificates

Accessories

Certification of Compliance

1.3 REGULATORY REQUIREMENT

All joist girder framing must conform to 29 CFR 1926.757. Secure all joist bridging and anchoring in place prior to the application of any construction loads. Distribute temporary loads so that joist capacity is not exceeded. Do not apply loads to bridging.

1.4 DELIVERY AND STORAGE

Handle, transport, and store joists and joist girders in a manner to prevent damage affecting their structural integrity. Store all items off the ground in a well drained location protected from the weather and easily accessible for inspection and handling.

1.5 QUALITY ASSURANCE

All work must comply with the requirements set forth in 29 CFR 1926.

1.5.1 Drawing Requirements

Submit steel joist framing drawings. Show joist type and size, layout in plan, and erection details including methods of anchoring, framing at openings, type and spacing of bridging, requirements for field welding, and details of accessories as applicable.

1.5.2 Certification of Compliance

Prior to construction commencement, submit Material Safety Data Sheetper 29 CFR 1910.1200 for steel joists , and certification for welder qualification, compliance with AWS B2.1, welding operation, and tacker, stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual

certifying the qualification tests.

Submit certification of compliance for the following:
SJI MANUAL
SJI TD 8
SJI TD 9
SJI TD 10
29 CFR 1926
29 CFR 1926.757

PART 2 PRODUCTS

2.1 JOISTS, JOIST GIRDERS, AND ACCESSORIES

Provide design data from SJI 279167 SPECS/LOADS for the joist series indicated.

2.2 PAINTING

2.2.1 Shop Painting

Clean and prime joists in accordance with SSPC Paint 15 and SSPC PS 14.01, Steel Joist Shop Painting System, using only Type I, "Red Oxide Paint." Finish coat of paint is specified in Section 09 90 00 PAINTING AND COATING.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Handling and Erection

Conform to SJI 279167 SPECS/LOADS for the joist series indicated.

3.1.2 Welding

All welding must conform to AWS B2.1 and AWS D1.1/D1.1M.

3.2 BEARING PLATES

Provide bearing plates to accept full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate must be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout must be as specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.3 PAINTING

3.3.1 Touch-Up Painting

After erection of joists and joist girders, touch-up connections and areas of abraded shop coat with paint of the same type used for the shop coat.

3.3.2 Field Painting

Paint joists and joist girders requiring a finish coat in conformance with the requirements of Section 09 90 00 PAINTING AND COATING.

3.4 VISUAL INSPECTIONS

3.4.1 Erection Inspection

AWS D1.1/D1.1M, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors. Welding inspectors must visually inspect and mark welds.

-- End of Section --

SECTION 05 30 00

STEEL DECKS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-913	(1991) LRFD Cold-formed Steel Design Manual
AISI SG03-3	(2002) Cold-Formed Steel Design Manual Set

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2008) Structural Welding Code - Sheet Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1008/A 1008M	(2007a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 108	(2007) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 570/A 570M	(1998) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by

	the Hot-Dip Process
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 792/A 792M	(2006a) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1149	(2007) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 746	(2007) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM DS 1-28	(2002) Design Wind Loads
FM P7825	(2005) Approval Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition

STEEL DECK INSTITUTE (SDI)

SDI 30	(2001) Design Manual for Composite Decks, Form Decks, and Roof Decks
SDI DDMO3	(3rd Edition) Diaphragm Design Manual
SDI DDP	(1987; R 2000) Deck Damage and Penetrations
SDI MOC2	(2006) Manual of Construction with Steel Deck

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(2002; E 2004) Paint Specification No. 20 Zinc-Rich Coating Type I Inorganic and Type II Organic

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-01	Load Assumptions for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 209	(2005; Rev thru May 2007) Cellular Metal Floor Raceways and Fittings
UL 580	(2006) Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	(2007) Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Metal Floor Deck Units

Cant Strips

Ridge and Valley Plates

Metal Closure Strips

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Joint Sealant Material

Mechanical Fasteners

Metal Floor Deck Units

Piston Tool Operator

Repair Paint

Sound Absorbing Material

Welder Qualifications

Welding Equipment

Welding Rods and Accessories

SD-04 Samples

Metal Roof Deck Units

Flexible Closure Strips

SD-05 Design Data

Deck Units

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

SD-07 Certificates

. Welding Procedures

Fire Safety

Wind Storm Resistance

1.3 QUALITY ASSURANCE

1.3.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide a 2 sq ft. sample of decking material and each accessory to be used. Provide a sample of acoustical material to be used. Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

1.3.2 Certification of Piston Tool Operator

Manufacturer's certificate attesting that the operators are authorized to use the low velocity piston tool.

1.3.3 Qualifications for Welding Work

Follows Welding Procedures in accordance with AWS D1.1/D1.1M. Test specimens shall be made in the presence of Contracting Officer and shall be tested by an approved testing laboratory at the Contractor's expense.

Submit qualified Welder Qualifications in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, perform an immediate retest of two test welds until each test weld passes. Failure in the immediate retest will require the welder be retested after further practice or training, performing a complete set of test welds.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

1.3.4 Regulatory Requirements

1.3.4.1 Fire Safety

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Bld Mat Dir, or listing as Class I construction in the FM P7825, and so labeled.

1.3.4.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding an uplift

pressure of 90 pounds per square foot when tested in accordance with the uplift pressure test described in the FM DS 1-28 or as described in UL 580 and in general compliance with UFC 3-310-01.

1.3.5 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. Must not exceed the design live load. The maximum uniform distributed storage load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

1.5 DESIGN REQUIREMENTS FOR ROOF DECKS

1.5.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI SG-913.

1.5.2 Allowable Loads

Indicate total uniform dead and live load for detailing purposes.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than indicated before coating, meeting the requirements of AISI SG03-3, except as modified herein.

2.1.2 Steel Coating

ASTM A 653/A 653M designation G90 galvanized, or ASTM A 792/A 792M designation AZ55, aluminum-zinc alloy. Apply coating to both sides of sheet. Conform to UL 209 for coating on decking provided as wire raceways.

2.1.3 Mixes

2.1.3.1 Galvanizing Repair Paint for Floor Decks

Provide a high-zinc-dust content paint for regalvanizing welds in galvanized steel conforming to ASTM A 780.

2.1.4 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A 36/A 36M, merchant quality, Grade Designation SAE/AISI 1023 or SAE/AISI 1025, and hot-dip galvanized in accordance with ASTM A 123/A 123M.

2.1.5 Joint Sealant Material for Roof Decks

Provide a nonskinning, gun-grade, bulk compound material as recommended by the manufacturer.

2.1.6 Galvanizing Repair Paint for Roof Decks

Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel and shall conform to ASTM A 780.

2.1.7 Flexible Closure Strips for Roof Decks

Provide strips made of elastomeric material specified and premolded to the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

Provide a vulcanized, closed-cell, expanded chloroprene elastomer having approximately 3.5 psi compressive-deflection at 25 percent deflection (limits), conforming to ASTM D 1056, Grade No. SCE 41, with the following additional properties:

Brittleness temperature of minus 40 degrees F when tested in accordance with ASTM D 746.

Flammability resistance with a flame spread rating of less than 25 when tested in accordance with ASTM E 84.

Resistance to ozone must be "no cracks" after exposure of a sample kept under a surface tensile strain of 25 percent to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 104 degrees F and tested in accordance with ASTM D 1149.

Provide a elastomeric type adhesive with a chloroprene base as recommended by the manufacturer of the flexible closure strips.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 Partition Closures

Provide closures for closing voids above interior walls and partitions that are perpendicular to the direction of the configurations. Provide rubber, plastic, or sheet steel closures above typical partitions. Provide sheet steel closures above fire-resistant interior walls and partitions located

on both sides of wall or partition.

2.2.3 Closure Plates for Composite Deck

Support and retain concrete at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Provide metal closures for all openings in composite steel deck 1/4 inch and over.

2.2.4 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.5 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

Fabricate cover plates for abutting floor deck units from the specified structural-quality steel sheets not less than nominalthick before galvanizing. Provide 6 inch wide cover plates and form to match the contour of the floor deck units.

2.2.6 Roof Sump Pans

Sump pans must be provided for roof drains and must be minimum 0.075 inch thick steel, flat, recessed type. Shape sump pans to meet roof slope by the supplier or by a sheet metal specialist. Provide bearing flanges of sump pans to overlap steel deck a minimum of 3 inch. Shape, size, and reinforce the opening in bottom of the sump pan to receive roof drain.

2.2.7 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.8 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.9 Hanger

Provide clips or loops for utility systems and suspended ceilings of one or more of the following types:

a. Lip tabs or integral tabs where noncellular decking or flat plate of cellular section is 0.0474 inch thick or more, and a structural concrete fill is used over deck.

b. Slots or holes punched in decking for installation of pigtails.

c. Tabs driven from top side of decking and arranged so as not to pierce electrical cells.

d. Decking manufacturer's standard as approved by the Contracting Officer.

2.2.10 Shear Connectors

Provide shear connectors as headed stud type, ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC 360 or strap type, ASTM A 570/A 570M, Grade D, hot-rolled carbon steel.

2.2.11 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 0.0474 inch; welding washers, 0.0598 inch cant strip, 0.0295 inch other metal accessories, 0.0358 inch unless otherwise indicated. Accessories must include but not be limited to saddles, welding washers, fasteners, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

2.3 FABRICATION

Furnish one sample of each type of Metal Floor Deck Units used to illustrate the actual cross section dimensions and configuration.

Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.

Furnish one sample of each type Flexible Closure Strips, 12 inch long.

2.3.1 Deck Units

2.3.1.1 Cellular Metal Floor Deck Units

Provide decking as wire raceways conforming to NFPA 70. Fabricate units from the specified structural-quality steel sheets. Provide nominal thickness of the steel sheets, before galvanizing, a minimum 18-gage for the upper element of the floor deck unit, and a minimum 16-gage for the lower element of the floor deck unit.

Provide sufficient welds, forming the steel sheets into the cellular floor deck unit, to develop the full horizontal shear at the plane where the steel sheets are joined.

Cellular metal floor deck units must be fluted section cells combined on a flat plate having interlocking type sidelaps. Provide depth, width of unit, number of cells per unit, and width of cells as follows:

DEPTH MINIMUM (inch)	WIDTH OF UNIT NOMINAL	NUMBER OF CELLS PER UNIT (inch)	WIDTH OF CELLS NOMINAL (inch)
1-1/2	24	4	3-5/8
1-1/2	24	2	9-5/8
1-1/2	12	1	9-5/8
3	24	3	5-5/8

DEPTH MINIMUM (inch)	WIDTH OF UNIT NOMINAL	NUMBER OF CELLS PER UNIT (inch)	WIDTH OF CELLS NOMINAL (inch)
3	24	2	9-5/8
3	12	1	9-5/8
4-1/2	24	4	2-5/8
4-1/2	24	2	9-5/8
4-1/2	12	1	9-5/8
6	24	2	9-5/8
6	12	1	9-5/8
7-1/2	24	2	9-5/8
7-1/2	12	1	9-5/8

Cellular metal floor deck units must be fluted section cells combined with a matching fluted bottom section having interlocking type sidelaps. Provide depth, width of unit, number of cells per unit, and width of cells as follows:

DEPTH MINIMUM (inch)	WIDTH OF UNIT NOMINAL (inch)	NUMBER OF CELLS PER UNIT	WIDTH OF CELLS NOMINAL (inch)
3	24	4	3-5/8
3	12	1	9-5/8
6	24	3	5-5/8

Conform to SDI 30 for deck units. Use panels of maximum possible lengths to minimize end laps. Fabricate deck units in lengths to span 3 or more supports with flush, telescoped, or nested 2 inch laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI SG03-3, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.3.2 Open Beam, Metal Floor Deck Units

Fabricate open beam metal floor deck units of the specified structural-quality steel sheets. Provide nominal thickness of the steel sheets before galvanizing of minimum 18-gage.

Provide open beam metal floor deck units with a fluted section having interlocking type sidelaps. Provide depth, width of unit, number of flutes per unit, and width of flutes as follows:

DEPTH MINIMUM (inch)	WIDTH OF UNIT NOMINAL (inch)	NUMBER OF CELLS PER UNIT	WIDTH OF CELLS NOMINAL (inch)
1-1/2	24	4	3-5/8
1-1/2	24	2	9-5/8
1-1/2	12	1	9-5/8
3	24	3	5-5/8
3	24	2	9-5/8
3	12	1	9-5/8
4-1/2	24	2	9-5/8
4-1/2	12	2	2-5/8
4-1/2	12	1	9-5/8
6	24	2	9-5/8
6	12	1	9-5/8
7-1/2	24	2	9-5/8
7-1/2	12	1	9-5/8

2.3.3 Length of Floor Deck Units

Provide floor deck units of sufficient length to span three or more spacings where possible.

2.3.4 Roof Deck

Conform to ASTM A 792/A 792M or ASTM A 1008/A 1008M for deck used in conjunction with insulation and built-up roofing. Fabricate roof deck units of 0.0295 inch design thickness or thicker steel galvanized G90 coating class or aluminum-zinc coated in accordance with ASTM A 792/A 792M Coating Designation AZ55.

2.3.4.1 Cant Strips for Roof Decks

Fabricate cant strips from the specified commercial-quality steel sheets not less than nominal 0.0359 inch thick before galvanizing. Bend strips to form a 45-degree cant not less than 5 inch wide, with top and bottom flanges a minimum 3 inch wide. Length of strips 10 feet.

2.3.4.2 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 0.0359 inch thick before galvanizing. Provide plates of minimum 4-1/2 inch wide and bent to provide tight fitting closures at ridges and valleys. Provide a minimum length of ridge and valley plates of 10 feet.

2.3.4.3 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 0.0359 inch thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

2.3.5 Form Deck

Conform to ASTM A 653/A 653M or ASTM A 1008 for deck used as formwork for concrete. Fabricate form deck of 0.015 inch design thickness or thicker steel or the steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A 653/A 653M, G90 coating class.

2.3.6 Shop Priming

Shop prime accessories and deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured.

2.3.7 Touch-Up Paint

Provide touch-up paint for shop-painted units of the same type used for the shop painting, and touch-up paint for zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content. Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the metal floor decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint. Touch up the painted surfaces with paint for the repair of painted surfaces.

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with SDI 30, SDI DDMO3 and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or

leveling to the Contracting Officer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Ends of floor deck may be lapped. Do not use unanchored deck units as a work or storage platform. Do not fill unanchored deck with concrete. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage. Prepare shoring in position before concrete placement begins in composite or form deck.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal5/8 inch diameter puddle welds or fastened with screws as indicated on the design drawings and in accordance with manufacturer's recommended procedure and SDI 30. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding or fastening. Anchoring the deck to structural supports with powder-actuated fasteners or pneumatically driven fasteners is prohibited. Attachment of adjacent deck units by button-punching is prohibited.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3/D1.3M using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.1/D1.1M and AWS D1.3/D1.3M make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. Indicate, Conform to the recommendations of the Steel Deck Institute and the steel deck manufacturer for location, size, and spacing of fastening. Do use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Lap 2 inch deck ends. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDMO3. Attach shear connectors as shown and welded as per AWS D1.1/D1.1M directly to the steel member. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A 780.

3.2.1.2 Fastening Floor Deck Units

Fasten floor deck units to the steel supporting members at ends and at all intermediate supports, both parallel and perpendicular to deck span, by welds. Do not exceed spacing of welds of 12 inch on center, with a minimum of two welds per floor deck unit at each support. Provide 3/4 inch minimum diameter fusion welds. Coordinate welding sequence and procedure with the placing of the floor deck units. Blow holes shall be cause for rejection.

Lock sidelaps between adjacent floor deck units together at intervals not exceeding 48 inch on center by welding or button punching for all spans.

3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Reinforce holes and openings

6 to 12 inch across by 0.0474 inch thick steel sheet at least 12 inch wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inch on center. Reinforce holes and openings larger than 12 inch by steel channels or angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists.

3.2.3 Deck Damage

SDI MOC2, for repair of deck damage.

3.2.4 Accessory Installation

3.2.4.1 Adjusting Plates

Install as shown on shop drawings.

3.2.4.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.4.3 Closures Above Partitions

Provide for closing voids between cells over partitions that are perpendicular to direction of cells. Provide a one-piece closure strip for partitions 4 inch nominal or less in thickness and two-piece closure strips for wider partitions. Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation. Provide flexible rubber closures above acoustic-rated partitions at both sides of partition with space between filled with blanket insulation.

3.2.4.4 Column Closures

Provide for spaces between floor decking and columns which penetrate the deck. Field cut closure plate to fit column in the field and tack weld to decking and columns.

3.2.4.5 Access Hole Covers

Provide to seal holes cut in decking to facilitate welding of decking to structural supports.

3.2.4.6 Hangers

Provide as indicated to support utility system and suspended ceilings.

3.2.5 Concrete Work

Prior to placement of concrete, inspect installed decking to ensure that there has been no permanent deflection or other damage to decking. Replace decking which has been damaged or permanently deflected as approved by the Contracting Officer. Place concrete on metal deck in accordance with Construction Practice of SDI 30.

3.2.6 Preparation of Fire-Proofed Surfaces

Provide deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, galvanized and free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Complete any required cleaning prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

3.3 JOINT SEALING FOR ROOF DECKS

Seal sidelaps and endlaps with manufacturer's recommended joint sealing material. Shop or field apply the material. Before applying the sealing material, completely remove dust, dirt, moisture, and other foreign material from the surfaces to which the sealing material is to be applied. Apply sealing material in strict accordance with the sealing material manufacturer's printed instructions.

3.4 ROOF SUMP PANS

Place sump pans over openings in roof decking and fusion welded to top surface of roof decking. Do not exceed spacing of welds of 12 inch with not less than one weld at each corner. Field cut opening in the bottom of each roof sump pan to receive the roof drain as part of the work of this section.

3.5 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 12 inch. Lap end joints a minimum 3 inch and secure with galvanized sheet metal screws spaced a maximum 4 inch on center.

3.6 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inch. For valley plates, provide endlaps to be in the direction of water flow.

3.7 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

3.8 ROOF INSULATION SUPPORT FOR ROOF DECKS

Provide metal closure strips for support of roof insulation where rib openings in top surface of metal roof decking occur adjacent to edges and openings. Weld metal closure strips in position.

3.9 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.10 FIELD QUALITY CONTROL

3.10.1 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges is 1/16 inch; when gap is more than 1/16 inch, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG02-1	(2001) North American Specification for the Design of Cold-Formed Steel Structural Members
AISI SG03-3	(2002) Cold-Formed Steel Design Manual Set

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3/D1.3M	(2008) Structural Welding Code - Sheet Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 370	(2007b) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(2007) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 955	(2007) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM E 329	(2007a) Standard Specification for

Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J78 (1998) Steel Self Drilling Tapping Screws

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Framing Components

a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

SD-03 Product Data

Steel studs,joists, tracks, bracing, bridging and accessories

SD-05 Design Data

Metal framing calculations

SD-07 Certificates

Load-bearing cold-formed metal framing

Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E 329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A 370.

Welds

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to job site and store in adequately ventilated, dry locations. Storage area shall permit easy access for inspection and handling. If necessary to store materials outside, stack off the ground, support on a level platform, and protect from the weather as approved.

Handle materials to prevent damage. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust. Replace damaged items with new, as directed by the Contracting Officer.

1.4 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI SG03-3. Non-load-bearing metal framing, furring, and ceiling suspension systems are specified in Section 09 22 00 METAL SUPPORT ASSEMBLIES. Metal suspension systems for acoustical ceilings are specified in Section 09 51 00 ACOUSTICAL CEILINGS.

1.5 MAXIMUM DEFLECTION

a. Exterior Studs:

Deflection Criteria	Exterior Finish
L/240 or L/360	Synthetic Plaster, Metal Panels
L/360	Cement Plaster, Wood Veneer
L/600	Brick Veneer, Stone Panels

Wall deflections shall be computed on the basis that studs withstand all lateral forces independent of any composite action from sheathing materials. Studs abutting windows or louvers shall also be designed not to exceed 1/4 inch maximum deflection.

b. Floor Joists:

L/360 - Live load only
L/240 - Total load

c. Roof Rafters:

L/240 - Live load only

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories.

1.6.2 Design Data Required

Submit metal framing calculations to verify sizes, gages, and spacing of members and connections. Show methods and practices used in installation.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C 955 and the following.

2.1.1 Studs and Joists of 16 Gage (0.0598 Inch) and Heavier

Galvanized steel, ASTM A 653/A 653M, SS Grade 50, G60.

2.1.2 Studs and Joists of 18 Gage (0.0478 Inch) and Lighter

Studs and Joists of 18 Gage (0.0478 Inch) and Lighter, Track, and Accessories (All Gages): Galvanized steel, ASTM A 653/A 653M, SS, Grade 50 33,000 psi G60.

2.1.3 Sizes, Gages, Section Modulus, and Other Structural Properties

Size and gage as indicated. Steel stud deflection shall be limited to L/600 for exterior wall brick veneer construction.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:

a. An ICBO number.

b. Manufacturer's identification.

c. Minimum delivered uncoated steel thickness.

d. Protective coating designator.

e. Minimum yield strength.

2.3 CONNECTIONS

Screws for steel-to-steel connections shall be self-drilling tapping in compliance with SAE J78 of the type, size, and location as shown on the drawings. Electroplated screws shall have a Type II coating in accordance with ASTM B 633. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate. Screws bolts, and anchors shall be hot dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate.

2.4 PLASTIC GROMMETS

Supply plastic grommets, recommended by stud manufacturer, to protect electrical wires. Prevent metal to metal contact for plumbing pipes.

PART 3 EXECUTION

3.1 FASTENING

Fasten framing members together by welding or by using self-drilling or self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

3.1.1 Welds

All welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI SG02-1. All welders, welding operations, and welding

procedures shall be qualified according to AWS D1.3/D1.3M. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 18 gage.

3.1.2 Screws

Screws shall be of the self-drilling self-tapping type, size, and location shown on the drawings. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI SG02-1. Screws covered by sheathing materials shall have low profile heads.

3.1.3 Anchors

Anchors shall be of the type, size, and location shown on the drawings.

3.2 INSTALLATION

3.2.1 Tracks

Provide accurately aligned runners at top and bottom of partitions. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 3 inches from the edge of concrete slabs.

3.2.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI SG03-3, consisting of, as a minimum, runner channel cut to fit between and welded to the studs or hot- or cold-rolled steel channels inserted through cutouts in web of each stud and secured to studs with welded clip angles. Bracing shall be not less than the following:

LOAD	HEIGHT	BRACING
Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

3.2.3 Joists and Trusses

Locate each joist or truss directly above a stud. Provide doubled joists under parallel partitions wherever partition length exceeds 1/2 of joist span. Joists shall have at least 2.50 inches of bearing on steel, 4 inches on masonry, and shall be reinforced over bearings where required to prevent

web crippling. Splice joists over bearings only. Lap and weld splices as indicated. Provide manufacturer's standard bridging which shall not be less than the following:

CLEAR SPAN	BRIDGING
Up to 14 feet	One row near center
14 to 20 feet	Two rows at 1/3 points
20 to 26 feet	Three rows at 1/4 points
26 to 32 feet	Four rows at 1/5 points

Temporary bracing shall be provided and remain in place until work is permanently stabilized.

3.2.4 Erection Tolerances

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/4 inch in 8 feet from a straight line;

(3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/4 inch in 8 feet from a true plane.

b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/8 inch in 8 feet from a straight line;

(3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/8 inch in 8 feet from a true plane.

3.2.5 Special Inspection and Testing for Seismic-Resisting Systems

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

SECTION 05 50 00

METAL: MISCELLANEOUS AND FABRICATIONS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA 46	(1978) Standards for Anodized Architectural Aluminum
AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2005) Code of Standard Practice for Steel Buildings and Bridges
AISC 350	(2005) Load and Resistance Factor Design (LRFD)Specification for Structural Steel Buildings
AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE/SAFE A10.3	(2006) Operations - Safety Requirements for Powder Actuated Fastening Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; Addenda A 1999; Errata 2003; R 2005) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts (Inch Series)
ASME B18.21.1	(1999; R 2005) Lock Washers (Inch Series)
ASME B18.22.1	(1965; R 2003) Plain Washers

ASME B18.6.2	(1998; R 2005) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2003) Machine Screws and Machine Screw Nuts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 467/A 467M	(2001) Standard Specification for Machine Coil and Chain
ASTM A 47/A 47M	(1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 475	(2003) Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 500/A 500M	(2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) Standard Specification for High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM A 786/A 786M	(2005) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A 924/A 924M	(2007) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 108	(2006) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 26/B 26M	(2005) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 429/B 429M	(2006) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E 814	(2006) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM F 1679	(2004e1) Standard Test Method for Using a Variable Incidence Tribometer

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Jan 2004) Alkyd Anti-Corrosive Metal Primer

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521	(2001) Pipe Railing Manual
NAAMM MBG 531	(2000) Metal Bar Grating Manual
NAAMM MBG 532	(2000) Heavy Duty Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2006; Errata 2006) Standard for Portable Fire Extinguishers

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(2004; E 2004) Power Tool Cleaning
SSPC SP 6	(2000; E 2004) Commercial Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27 Fixed Ladders

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication drawings of steel stairs

Fabrication drawings of structural steel door frames

Access doors and panels, installation drawings

Cover plates and frames, installation drawings

Expansion joint covers, installation drawings

Floor gratings and roof walkways, installation drawings

Handrails, installation drawings

Ladders, installation drawings

Wheel guards, installation drawings

Window and door guards, installation drawings

Ship's ladder (with or without guards), installation drawings

Embedded angles and plates, installation drawings

Roof hatch

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Access doors and panels

Cover plates and frames

Control-joint covers

Expansion joint covers

Floor gratings and roof walkways

Handrails

Ladders

Steel stairs

Steel Stairs, circular

Structural steel door frames

Wheel guards

Window and door guards

Ship's ladder (with or without guards)

Roof hatch

SD-04 Samples

Expansion joint covers

Control-joint covers

Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A 36/A 36M.

2.1.2 Structural Tubing

ASTM A 500/A 500M.

2.1.3 Steel Pipe

ASTM A 53/A 53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A 47/A 47M.

2.1.5 Gratings

a. Gray cast iron ASTM A 48/A 48M, Class 40.

b. Metal plank grating, non-slip requirement, aluminum ASTM B 209, 6061-T6; steel ASTM A 653/A 653M, G90.

c. Metal bar type grating NAAMM MBG 531, NAAMM MBG 532.

2.1.6 Floor Plates, Patterned

Floor plate ASTM A 786/A 786M. Steel plate shall not be less than 14 gage.

2.1.7 Anchor Bolts

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.7.1 Expansion Anchors or Sleeve Anchors

Provide 5/8-inch diameter expansion anchors or sleeve anchors. Minimum concrete or masonry embedment shall be 4-inch.

2.1.7.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.7.3 Toggle Bolts

ASME B18.2.1.

2.1.7.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 and ASTM A 687 or ASTM A 307.

2.1.7.5 Powder Driven Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.7.6 Screws

ASME B18.2.1, ASME B18.6.2, and ASME B18.6.3.

2.1.7.7 Washers

Provide plain washers to conform to ASME B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.8 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123/A 123M, ASTM A 153/A 153M, ASTM A 653/A 653M or ASTM A 924/A 924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF-45, or AA 46. Unless otherwise specified, all other aluminum items shall have standard mill finish. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish.

2.3 ACCESS DOORS AND PANELS

Provide flush type access doors and panels unless otherwise indicated. Fabricate frames for access doors of steel not lighter than 14 gage with welded joints and anchorage for securing into construction. Provide access doors with a minimum of 14 by 20 inches and of not lighter than 14 gage steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, turn-screw-operated latch. Provide exposed metal surface with a baked enamel finish.

Provide ceiling access panels for terminal air blenders as indicated. Provide pin-tumbler cylinder locks with appropriate cams in lieu of screwdriver-operated latches.

2.4 CONTROL-JOINT COVERS

Provide control-joint covers to be located on wall surfaces of concrete, masonry and tile work. Provide protective coating on the surface in contact with concrete, masonry or tile.

2.5 COVER PLATES AND FRAMES

Fabricate cover plates of 1/4 inch thick rolled steel weighing not more than 100 pounds per plate with a selected raised pattern nonslip top surface. Plate shall be galvanized. Frames shall be structural steel shapes and plates, with bent steel bars or headed anchors welded to frame for anchoring to concrete. Miter and weld all corners. Butt joint straight runs. Allow for expansion on straight runs over 15 feet. Provide holes for lifting tools. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Weld bar stops every six inches. Provide 1/8 inch clearance at edges and between cover plates.

2.6 EXPANSION JOINT COVERS

Provide expansion joint covers constructed of extruded aluminum with anodized satin aluminum finish for walls and ceilings and with standard mill finish for floor covers and exterior covers. Furnish plates, backup angles, expansion filler strip and anchors as indicated.

2.7 EXTRUDED FLOOR MAT FRAMES

Provide recess frames for roll-up floor mats of extruded 6063-T5 aluminum, in sizes shown. Miter corners to ensure accurate fitting. Determine depth of recess by the mat thickness. Anchor frames in concrete with anchor pins or bolts. Roll-up mats shall be of aluminum construction with carpet surface. Roll-up mats shall be for use in level surface area or recessed area, as indicated. Construction details of recessed areas shall be shown

on the drawings.

2.8 FLOOR GRATINGS AND ROOF WALKWAYS

Design steel grating in accordance with NAAMM MBG 531 for bar type grating or manufacturer's charts for plank grating. Galvanize steel floor gratings.

a. Design floor gratings to support a live load of 40 pounds per square foot for the spans indicated, with maximum deflection of L/240.

b. NAAMM MBG 531, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and match grating finish.

c. Attach gratings to structural members with welded-on anchors. (or) Anchor gratings to structural members with bolts, toggle bolts, or expansion shields and bolts.

d. Slip resistance requirements must exceed both wet and dry a static coefficient of friction of 0.5, 0.6 as tested in accordance with ASTM F 1679.

e. Rooftop walkway: Minimum 2 feet wide, 14 gage, ASTM A 653/A 653M, G-90, steel with slip resistant surface. Furnish all brackets, connectors and other accessories. Support at minimum 5 foot intervals on hard rubber pads in accordance with manufacturers instructions.

2.9 GAS-TIGHT MANHOLE COVER AND FRAME

Provide a heavy duty type made of ductile cast-iron with bolted lid, machined bearing surfaces and gasket grooves, continuous neoprene gasket, counter sunk bronze hex head cap screws, and concealed watertight pickholes. Provide frame with a 30 inch diameter clear opening. Maximum weight of frame and cover together to be 530 pounds.

2.10 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide 4 inch galvanized standard weight steel pipe as specified in ASTM A 53/A 53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.11 HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 20 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.

2.11.1 Steel Handrails, Including Carbon Steel Inserts

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A 53/A 53M or structural tubing conforming to ASTM A 500/A 500M, Grade A or B of equivalent strength. Provide steel railings of 2 inches nominal size. Railings to be hot-dip galvanized.

a. Fabrication: Joint posts, rail, and corners by one of the following methods:

(1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

(2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

2.11.2 Aluminum Handrails

Consists of 2 inch nominal schedule 40 pipe ASTM B 429/B 429M, 1 3/4 inch square aluminum semi-hollow tube with rounded corners ASTM B 221. Railings shall be mill finish. All fasteners shall be Series 300 stainless steel.

a. Fabrication: Provide jointing by one of the following methods:

(1) Flush-type rail fittings, welded and ground smooth with splice locks secured with 3/8 inch recessed head set screws.

(2) Mitered and welded joints made by fitting post to top rail, intermediate rail to post, and corners, shall be groove welded and ground smooth. Splices, where allowed by the Contracting Officer , shall be butted and reinforced by a tight fitting dowel or sleeve not less than 6 inches in length. Tack weld or epoxy cement dowel or sleeve to one side of the splice.

(3) Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 1/4 or 3/8 inch stainless steel recessed head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B 26/B 26M.

2.12 LADDERS

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 2 1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Rungs to be not less than 16 inches wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 7 inches. Provide heavy clip angles riveted or bolted to the stringer and drilled for not less than two 1/2 inch diameter expansion bolts as indicated. Provide intermediate clip angles not over 48 inches on centers.

2.12.1 Ladder Cages

Conform to 29 CFR 1910.27. Fabricate 2 by 1/4 inchhorizontal bands and 1

1/2 by 3/16 inch vertical bars. Provide attachments for fastening bands to the side rails of ladders or directly to the structure. Provide and fasten vertical bars on the inside of the horizontal bands. Extend cages not less than 27 inches or more than 28 inches from the centerline of the rungs, excluding the flare at the bottom of the cage, and not less than 27 inches in width. Clear the inside of the cage of projections.

2.12.2 Ship's Ladder

Fabricate stringers and framing of steel plate or shapes. Bolt, rivet or weld connections and anchor to supporting construction. Provide treads with non-slip surface as specified for safety treads. Requirements shown or specified for steel apply. Provide anchor items of zinc-coated steel. Design assembly, including tread connections and methods of attachment, to support a live load of 300 pounds per tread. Provide railings as specified for metal handrails.

2.13 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, support framing for ceiling-mounted toilet partitions, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and fasteners. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123/A 123M.

2.14 SAFETY CHAINS AND GUARDRAILS

Construct safety chains of galvanized steel, straight link type, 3/16 inch diameter, with at least twelve links per foot, and with snap hooks on each end. Safety chain shall be tested in accordance with ASTM A 467/A 467M, Class CS. Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Provide bolts and nuts as indicated, and to conform to the requirements of ASTM A 307. Locate safety chain where indicated. Mount the top chain feet 6 inches above the floor and mount the lower chain 2 feet above the floor.

2.15 SAFETY NOSINGS FOR CONCRETE TREADS

Provide safety nosings of cast iron with cross-hatched abrasive-surfaces, or extruded aluminum with abrasive inserts. Nosing to be at least 4 inches wide and 1/4 inch thick and terminating at not more than 6 inches from the ends of treads. For metal-pan cement-filled treads extending the full length of the tread for stairs and for platforms and landings. Provide safety nosings with anchors embedded a minimum of 3/4 inch in the concrete and with tops flush with the top of the traffic surface.

2.16 SECURITY GRILLES

Fabricate of channel frames with not less than two masonry anchors at each jamb and 1/2 inch hardened steel bars spaced not over 4 inches both ways and welded to frame. Provide 18 by 16 mesh screen and two layers of 1/4

inch hardware cloth clamped to frame.

2.17 STEEL STAIRS

Provide steel stairs complete with stringers, steel-plate treads and risers, metal-pan concrete-filled treads, grating treads, nonskid metallic treads, precast concrete treads, landings, columns, handrails, and necessary bolts and other fastenings. Steel stairs and accessories to be hot-dip galvanized.

2.17.1 Design Loads

Design stairs to sustain a live load of not less than 100 pounds per square foot. Conform to AISC 360 or AISC 350 with the design and fabrication of steel stairs, other than a commercial product.

2.17.2 Materials

Provide steel stairs of welded construction except that bolts may be used where welding is not practicable. Screw or screw-type connections are not permitted.

a. Structural Steel: ASTM A 36/A 36M.

b. Gratings for Treads and Landings: NAAMM MBG 531; ASTM A 653/A 653M, G-90 for steel; ASTM B 209 for aluminum. Provide gratings with nonslip nosings.

c. Support metal pan for concrete fill on angle cleats welded to stringers or treads with integral cleats, welded or bolted to the stringer. Provide sheet-steel landings with angle stiffeners welded on. Close exposed ends. Exterior stairs shall have all exposed joints formed to exclude water.

d. Before fabrication, obtain necessary field measurements and verify drawing dimensions.

e. Clean metal surfaces free from mill scale, flake rust and rust pitting prior to shop finishing. Weld permanent connections. Finish welds flush and smooth on surfaces that will be exposed after installation.

2.18 STRUCTURAL STEEL DOOR FRAMES

a. Provide frames as indicated. If not otherwise shown, construct frames of structural shapes, or shape and plate composite, to form a full depth channel shape with at least 1 1/2 inchoutstanding legs. For single swing doors, provide continuous 5/8 by 1 1/2 inch bar stock stops at head and jambs. For freight elevator hoistway entrance, include a non-skid metal sill as indicated.

b. Where track, guides, hoods, hangers, operators, and other such accessories are required, provide support as indicated.

c. Provide jamb anchors near top, bottom, and at not more than 24 inch intervals. Provide the bottom of each jamb member with a clip angle welded in place with two 1/2 inchdiameter floor bolts for adjustment.

d. Provide spreaders between bottoms of floor jamb members. When floor construction permits, they may be left in place, concealed in the floor.

2.19 WHEEL GUARDS

Provide wheel guards of hollow, heavy-duty type cast iron conforming to ASTM A 48/A 48M, with shaped, half round top, at least 18 inches high, and designed to provide a minimum of 6 inches of protection.

2.20 WINDOW GUARDS, DIAMOND-MESH TYPE

Provide diamond-mesh window guards constructed of woven steel wire or expanded metal framed with hot-rolled or cold-formed structural steel shapes. Provide woven wire panels of 10 gage, 1 1/2 inch mesh secured through weaving bar to one by 1/2 by 1/8 inchthick channel frame. Miter and weld corners of frames. Mount window guards on exterior of window frame to masonry jamb with toggle bolts, or to concrete jambs and solid masonry jambs with expansion shields and bolts. Provide galvanized guards and accessories.

2.21 WINDOW GUARDS, WOVEN WIRE

Provide woven wire window guards of size necessary to completely fill opening. Construct guards with 3/8 inch round rod frame and 1 1/2 inch diamond-mesh of No. 10 U.S. Gage (0.135 diameter) wire; all material zinc-coated.

2.22 DOWNSPOUT BOOTS

Downspout boots shall be cast iron with receiving bells sized to fit downspouts.

2.23 FOUNDATION VENTS

Foundation vents shall be the same size as the masonry units or sized as indicated, and shall be of extruded aluminum with integral water stop and sliding interior closer or damper operable from the outside. Insect screen shall be provided at the back of the vent. Louvered opening shall have top and bottom drip lips, and the net ventilating area with closer or damper open shall be at least 35 percent of the gross wall opening. The frames shall have a structural strength adequate to permit use in masonry walls without a lintel.

2.24 GUY CABLES

Guy cables shall be prestretched, galvanized wire rope of the sizes indicated. Wire rope shall conform to ASTM A 475, high strength grade with Class A coating. Guys shall have a factory attached clevis top-end fitting; guys shall have a factory attached open-bridge strand socket bottom-end fitting; guys shall be complete with oval eye, threaded anchor rods. Fittings and accessories shall be hot-dip galvanized.

2.25 WINDOW SUB-SILL

Window sub-sill shall be of extruded aluminum alloy of size and design indicated. Not less than two anchors per window section shall be provided for securing into mortar joints of masonry sill course. Sills for banks of windows shall have standard mill finish with a protective coating, prior to

shipment, of two coats of a clear, colorless, methacrylate lacquer applied to all surfaces of the sills.

2.26 WINDOW WELLS

Window wells shall be not lighter than 16 gauge,corrugated sheet steel, hot-dip galvanized after fabrication. Top edge of walls shall have a 3/4 inch bead or rolled top. Window wells shall be semicircular or semielliptical in form and shall overlap the window by at least 3 inches on each side. Removable cover, hot-dip galvanized after fabrication, consisting of steel bar grate with bars spaced at not more than 2 inch centers and welded to 1 by 1/4 inch frame shall be designed to fit into and rest on top edge of window well.

2.27 FIRE EXTINGUISHER CABINETS

Cabinets to be located in fire-rated walls shall be fire-rated type, fabricated in accordance with ASTM E 814, and shall be listed by an approved testing agency for 1- and 2-hour combustible and non-combustible wall systems. The testing agency's seal shall be affixed to each fire-rated cabinet. Cabinets shall be of the recessed type suitable for 2-1/2 gallon, 10 pound extinguishers. Box and trim shall be of heavy gage rolled steel. Door shall be a rigid frame with full length piano type hinge and double strength (DSA) glass panel. Door and panel shall be prime-coated inside and out, have the manufacturer's standard white baked enamel finish inside and out.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.Items listed below require additional procedures.

3.2 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.6 FINISHES

3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.6.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

3.7 ACCESS PANELS

Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.8 CONTROL-JOINT COVERS

Provide covers over control-joints and fasten on one side only with fasteners spaced to give positive contact with wall surfaces on both sides

of joint throughout the entire length of cover.

3.9 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

3.10 HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.10.1 Steel Handrail

Install in pipe sleeves embedded in concrete and filled with non-shrink grout or quick setting anchoring cement with anchorage covered with standard pipe collar or masonry with expansion shields and bolts or toggle bolts. Secure rail ends by steel pipe flanges anchored by expansion shields and bolts.

3.10.2 Aluminum Handrail

Affix to base structure by flanges anchored to concrete or other existing masonry by expansion shields. Provide Series 300 stainless steel bolts to anchor aluminum alloy flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or concrete, give the contact surface a heavy coating of bituminous paint.

3.11 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to masonry or concrete with not less than two 1/2 inch diameter expansion bolts. Install intermediate clip angles not over 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. In no case shall ends of ladders rest upon finished roof, floor.

3.12 STEEL STAIRS

Provide anchor bolts, grating fasteners, washers, and all parts or devices necessary for proper installation. Provide lock washers under nuts.

3.13 WHEEL GUARDS

Anchor guards to concrete or masonry in accordance with manufacturer's instructions. Fill hollow cores solid with concrete with minimum compressive strength of 2500 psi.

3.14 ROOF HATCH (SCUTTLES)

Shall be of aluminum with 3 inch beaded flange, welded and ground at corner. Provide a minimum clear opening of 30 by 36 inches. Construction and accessories shall be as follows:

a. Insulate cover and curb with one inch thick rigid fiberboard insulation covered and protected by aluminum sheet steel liner not less than 26 gage. Curb shall be 12 inches high, formed with 3 inch mounting flange with holes provided for securing to the roof

deck. Equip the curb with an integral metal cap flashing of the same gage and metal as the curb, full welded and ground at corners for weather tightness.

b. Provide hatch completely assembled with pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles on inside and outside, and neoprene draft seal. Provide fasteners for padlocking on the inside. Equip the cover with an automatic hold-open arm complete with grip handle to permit one-hand release. Cover action shall be smooth through its entire range with an operating pressure of approximately 30 pounds.

3.15 DOOR GUARD FRAME

Door guard frame shall be mounted over the glazed opening using 1/4 inch lag bolts on the interior of wood doors or tamperproof through bolts on the interior of metal doors.

3.16 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in Section 03 31 00.00 10 having a compressive strength of 3000 psi.

3.17 INSTALLATION OF DOWNSPOUT BOOTS

Downspouts shall be secured to building through integral lips with appropriate fasteners.

3.17 RECESSED FLOOR FRAMES & MATS

Contractor shall verify field measurements prior to releasing materials for fabrication by the manufacturer. A mat frame shall be used to ensure recess accuracy in size, shape and depth. Drain pit shall be formed by blocking out concrete when frames are installed. Pit shall be dampproofed after concrete has set. Frames shall be assembled onsite and installed so that upper edge will be level with finished floor surface. A cement base shall be screeded inside the mat recess frame area using the edge provided by the frame as a guide. The frame shall be anchored into the cement with anchor pins a minimum of 24 inches on centers.

3.18 MOUNTING OF SAFETY CHAINS

Safety chains shall be mounted 3 feet 6 inches and 2 feet above the floor.

3.19 INSTALLATION OF SAFETY NOSINGS

Nosing shall be completely embedded in concrete before the initial set of the concrete occurs and shall finish flush with the top of the concrete surface.

3.20 STRUCTURAL STEEL DOOR FRAMES

Door frames shall be secured to the floor slab by means of angle clips and expansion bolts. Continuous door stops shall be welded to the frame or tap screwed with countersunk screws at no more than 18 inchcenters, assuring in either case full contact with the frame. Any necessary reinforcements shall be made and the frames shall be drilled and tapped as required for

hardware.

3.21 INSTALLATION OF WHEEL GUARDS

Wheel guards shall be filled with concrete and anchored to the floor or the building according to the manufacturer's recommendations.

3.22 BAR-GRILLE WINDOW GUARDS

Bar-grille window guards shall be securely anchored to masonry with 1/2 inch diameter prison-type screws or bolts and expansion shields, or other type of fastenings if the ends of such fastenings are welded to the adjoining metal grilles or otherwise made tamperproof in a satisfactory manner. Spanner-head screws or bolts are not considered prison-type fasteners.

3.23 DIAMOND MESH WINDOW GUARDS

Diamond mesh window guards shall be mounted on interior window frame with not less than two tamperproof hinged butts mounted on wood jambs, exterior of window frame with not less than two tamperproof hinged butts mounted on 1 by 12 by 1/8 inch jamb channel attached as indicated to 2 by 1/4 inch plate anchored to wood jamb with 1/4 inch lag bolt, to masonry jamb with toggle bolts, or to concrete jambs and solid masonry jambs with expansion shields and bolts. One additional butt shall be provided for each 3 foot internal length of guard over 5 feet. Hasp and padlock shall be installed on the jamb opposite to that hinged.

3.24 INSTALLATION OF WINDOW WELLS

Window wells shall be placed as shown with the walls securely anchored to foundation surface. The area within the well shall be excavated to the bottom of the well and covered with a 4 inch thick layer of coarse gravel or crushed rock.

3.25 INSTALLATION OF FIRE EXTINGUISHER CABINETS

Metal fire extinguisher cabinets shall be furnished and installed in accordance with NFPA 10 where shown on the drawings or specified.

-- End of Section --

SECTION 06 10 00

ROUGH CARPENTRY

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T10	(2001) Wood Frame Construction Manual for One- and Two-Family Dwellings
AF&PA T101	(2001) National Design Specification (NDS)for Wood Construction

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(2004) Basic Hardboard

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC 111	(2005) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection
AITC A190.1	(2002) Structural Glued Laminated Timber
AITC OT-01	(2004) Timber Construction Manual

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20	(1970) American Softwood Lumber Standard

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C20	(2003) Structural Lumber Fire-Retardant Treatment by Pressure Processes
AWPA C27	(2002) Plywood - Fire-Retardant Treatment by Pressure Processes
AWPA C28	(2003) Standard for Preservative Treatment of Structural Glued Laminated Members and

	Lamination Before Gluing of Southern Pine, Coastal Douglas Fir, Hemfir and Western Hemlock by Pressure Processes
AWPA C9	(2003) Plywood - Preservative Treatment by Pressure Processes
AWPA M2	(2001) Standard for Inspection of Treated Wood Products
AWPA M6	(1996) Brands Used on Forest Products
AWPA P17	(2001; R 2002) Fire Retardant Formulations
AWPA P18	(2004) Nonpressure Preservatives
AWPA P5	(2005) Standard for Waterborne Preservatives
AWPA T1	(2004; R 2005) Use Category System: Processing and Treatment Standard
AWPA U1	(2004; R 2005) Use Category System: User Specification for Treated Wood

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E30	(2005) Engineered Wood Construction Guide
APA E445S	(2001; R 2002) Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)
APA EWS R540C	(1995; R 1996) Builder Tips Proper Storage and Handling of Glulam Beams
APA EWS T300E	(2005) Technical Note: Glulam Connection Details
APA F405L	(1999) Performance Rated Panels
APA PS 1	(1995) Voluntary Product Standard for Construction and Industrial Plywood
APA PS 2	(2004) Voluntary Product Standard for Wood-Based Structural-Use Panels

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; Addenda A 1999; Errata 2003; R 2005) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts (Inch Series)
ASME B18.5.2.1M	(2006) Metric Round Head Short Square Neck Bolts

ASME B18.5.2.2M	(1982; R 2005) Metric Round Head Square Neck Bolts
ASME B18.6.1	(1981; R 1997) Wood Screws (Inch Series)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 687	(1993) Standard Specification for High-Strength Nonheaded Steel Bolts and Studs
ASTM C 1136	(2006) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM D 1435	(2005) Standard Practice for Outdoor Weathering of Plastics
ASTM D 1972	(1997; R 2005) Standard Practice for Generic Marking of Plastic Products
ASTM D 198	(2005a) Standard Test Methods of Static Tests of Lumber in Structural Sizes
ASTM D 2344/D 2344M	(2000; R 2006) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM D 2898	(2007) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM D 3498	(2003) Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
ASTM D 6007	(2002) Standard Test Method for Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber
ASTM D 6108	(2003) Standard Test Method for Compressive Properties of Plastic Lumber and Shapes
ASTM D 6109	(2005) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products
ASTM D 6111	(2003) Standard Test Method for Bulk Density and Specific Gravity of Plastic

	Lumber and Shapes by Displacement
ASTM D 6112	(1997; R 2005) Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
ASTM D 6117	(1997; R 2005) Standard Test Methods for Mechanical Fasteners in Plastic Lumber and Shapes
ASTM D 6330	(1998; R 2003) Standard Practice for Determination of Volatile Organic Compounds (Excluding Formaldehyde) Emissions from Wood-Based Panels Using Small Environmental Chambers Under Defined Test Conditions
ASTM D 696	(2003) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM E 1333	(1996; R 2002) Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM F 1667	(2005) Driven Fasteners: Nails, Spikes, and Staples
ASTM F 547	(2006) Nails for Use with Wood and Wood-Base Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM DS 1-49	(2000) Perimeter Flashing

GREEN SEAL (GS)

GS-36	(2000) Commercial Adhesives

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2006; Errata 2006; Errata 2007; Supplement 2007; Errata 2007) International Building Code

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(2003) Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(2003) Standard Grading Rules for Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

RIS Grade Use (1998) Redwood Lumber Grades and Uses

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (1989; R 2005) Adhesive and Sealant Applications

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec (1986; Supple. No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003 (2002) Standard Grading Rules for Southern Pine Lumber

TRUSS PLATE INSTITUTE (TPI)

TPI 1 (2002) National Design Standard for Metal Plate Connected Wood Truss Construction; Commentary and Appendices

TPI HIB (1991) Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses

U.S. DEPARTMENT OF COMMERCE (DOC)

PS-58 (1974) Basic Hardboard

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1923 (Rev A; Notice 1) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

CID A-A-1924 (Rev A; Notice 1) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors

CID A-A-1925 (Rev A; Notice 1) Shield Expansion (Nail Anchors)

FS FF-B-588 (Rev E) Bolt, Toggle: and Expansion Sleeve, Screw

FS FF-T-1813 (Basic) Tack

FS MM-T-371 (Rev E) Ties, Railroad, Wood (Cross and Switch)

FS UU-B-790 (Rev A) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and

Fire Resistant)

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (2000) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 (1998) Western Lumber Grading Rules

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Structural glued laminated members

Trussed rafters

Trussed joists

Fabricated structural members

Modifications of structural members

Drawings of structural laminated members, fabricated wood trusses, engineered wood joists and rafters, and other fabricated structural members indicating materials, shop fabrication, and field erection details; including methods of fastening.

Nailers and Nailing Strips

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-05 Design Data

Modifications of structural members

Design analysis and calculations showing design criteria used to accomplish the applicable analysis.

SD-06 Test Reports

Preservative-treated lumber and plywood

SD-07 Certificates

Forest Stewardship Council (FSC) Certification; (LEED)

Certificates of grade

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Preservative treatment

SD-10 Operation and Maintenance Data

Plastic

When not labeled, identify types in Operation and Maintenance Manual.

Take-back program

Include contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store, protect, handle, and install prefabricated structural elements in accordance with manufacturer's instructions and as specified. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Store wood I-beams and glue-laminated beams and joists on edge. Adhere to requirements for stacking, lifting, bracing, cutting, notching, and special fastening requirements. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.4.2 Structural Glued Laminated Timber

Mark each member with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of

structural glued laminated timber products. The marking shall indicate compliance with AITC A190.1 and shall include all identification information required by AITC A190.1. Structurally end-jointed lumber shall also be certified and grade marked in accordance with AITC A190.1.

1.4.3 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA PS 1.Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

1.4.4 Structural-Use and OSB Panels

Mark each panel with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the panel. The mark shall indicate end use, span rating, and exposure durability classification. Oriented Strand Board (OSB), APA F405L.

1.4.5 Preservative-Treated Lumber and Plywood

The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.6 Fire-Retardant Treated Lumber

Mark each piece in accordance with AWPA M6, except pieces that are to be natural or transparent finished. In addition, exterior fire-retardant lumber shall be distinguished by a permanent penetrating blue stain. Labels of a nationally recognized independent testing agency will be accepted as evidence of conformance to the fire-retardant requirements of AWPA M6.

1.4.7 Hardboard, Gypsum Board, and Fiberboard

Mark each sheet or bundle to identify the standard under which the material is produced and the producer.

1.4.8 Plastic Lumber

Label plastic products to be incorporated into the project in accordance with ASTM D 1972, or provide product data indicating polymeric information in the Operation and Maintenance Manual.

a. Type 1: Polyethylene Terephthalate (PET, PETE).
b. Type 2: High Density Polyethylene (HDPE).
c. Type 3: Vinyl (Polyvinyl Chloride or PVC).
d. Type 4: Low Density Polyethylene (LDPE).
e. Type 5: Polypropylene (PP).
f. Type 6: Polystyrene (PS).
g. Type 7: Other. Use of this code indicates that the package in

question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

1.5 SIZES AND SURFACING

ALSC PS 20 for dressed sizes of yard and structural lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

a. Framing lumber and boards - 19 percent maximum

b. Timbers 5 inches and thicker - 25 percent maximum

c. Roof planking - 15 percent maximum

d. Materials other than lumber - Moisture content shall be in accordance with standard under which the product is produced

1.7 PRESERVATIVE TREATMENT

Treat wood products with waterborne wood preservatives conforming to AWPA P5. Pressure treatment of wood products shall conform to the requirements of AWPA U1 and AWPA T1. Pressure-treated wood products shall not contain arsenic, chromium, or other agents classified as carcinogenic, probably carcinogenic, or possibly carcinogenic to humans (compounds in Groups 1, 2A, or 2B) by the International Agency for Research on Cancer (IARC), Lyon, France. Pressure-treated wood products shall not exceed the limits of the U.S. EPA's Toxic Characteristic Leaching Procedure (TCLP), and shall not be classified as hazardous waste. Submit certification from treating plant stating chemicals and process used and net amount of preservatives retained are in conformance with specified standards.lumber and timber in accordance with AWPA C1 and AWPA C2, and plywood in accordance with AWPA C1 and AWPA C9. Treat structural glued laminated timber in accordance with AWPA C1 and AWPA C28.

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use. 0.60 pcf intended for Ammoniacal Copper Quaternary Compound (ACQ)-treated foundations. 0.80 to 1.00 pcf intended for ACQ-treated pilings. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Minimize cutting and avoid breathing sawdust. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. Plastic lumber shall not be preservative treated. The following items shall be preservative treated:

1. Wood framing, woodwork, and plywood up to and including the

subflooring at the first-floor level of structures having crawl spaces when the bottoms of such items are 24 inches or less from the earth underneath.

2. Wood members that are in contact with water.

3. Exterior wood steps, platforms, and railings; and all wood framing of open, roofed structures.

4. Wood sills, soles, plates, furring, and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.

5. Nailers, edge strips, crickets, curbs, and cants for roof decks.

1.7.1 Existing Structures

Use borate, permathrin, or a sodium silicate wood mineralization process to treat wood. Use borate for interior applications only.

1.7.2 New Construction

Use a boron-based preservative conforming to AWPA P18, sodium silicate wood mineralization process, or Ammoniacal Copper Quaternary Compound to treat wood. Use boron-based preservatives for above-ground applications only.

1.8 FIRE-RETARDANT TREATMENT

Fire-retardant treated wood shall be pressure treated in accordance with AWPA C20 for lumber and AWPA C27 for plywood. Material use shall be defined in AWPA C20 and AWPA C27 for Interior Type A and B and Exterior Type. with fire retardants conforming to AWPA P17. Fire retardant treatment of wood products shall conform to the requirements of AWPA U1, Commodity Specification H and AWPA T1, Section 8.8. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D 2898 prior to being tested. Such items which will not be inside a building, and such items which will be exposed to heat or high humidity, shall receive exterior fire-retardant treatment. Fire-retardant-treated wood products shall be free of halogens, sulfates, ammonium phosphate, and formaldehyde.

1.9 QUALITY ASSURANCE

1.9.1 Drawing Requirements

For fabricated structural members, trusses, qlu-lam members, indicate materials, details of construction, methods of fastening, and erection details. Include reference to design criteria used and manufacturers design calculations. Submit drawings for all proposed modifications of structural members. Do not proceed with modifications until the submittal has been approved.

1.9.2 Data Required

Submit calculations and drawings for all proposed modifications of

structural members. Do not proceed with modifications until the submittal has been approved.

1.9.3 Certificates of Grade

Submit certificates attesting that products meet the grade requirements specified in lieu of grade markings where appearance is important and grade marks will deface material.

1.9.4 Humidity Requirements

Sequence work to minimize use of temporary HVAC to dry out building and control humidity.

1.9.5 Plastic Lumber Performance

Plastic lumber intended for use in exterior applications shall have no fading or discoloration and no change in dimensional stability as tested in accordance with ASTM D 1435 for a period of 1, 3, 5 years.

1.10 ENVIRONMENTAL REQUIREMENTS

During and immediately after installation of treated wood, engineered wood products, and laminated wood products at interior spaces, provide temporary ventilation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Engineered Wood Products

Products shall contain no added urea-formaldehyde. Determine formaldehyde concentrations in air from engineered wood products under test conditions of temperature and relative humidity in accordance with ASTM D 6007 or ASTM E 1333. Determine Volatile Organic Compounds (VOCs), excluding formaldehyde, emitted from manufactured wood-based panels in accordance with ASTM D 6330.

2.1.2 Plastic Lumber

HDPE lumber shall contain a minimum of 75 to 100 percent recycled content, with a minimum of 25 to 100 percent post-consumer recycled content. Mixed plastics and cellulose lumber shall contain a minimum of 100 percent recycled content, with a minimum of 50 percent post-consumer recycled content. HDPE/fiberglass lumber shall contain a minimum of 95 percent recycled content with a minimum of 75 percent post-consumer recycled content. Other mixed resin lumber shall contain a minimum of 95 percent recycled content with a minimum of 50 percent post-consumer recycled content.

2.1.2.1 Shear Parallel to Length

Maximum 1,000 psi in accordance with ASTM D 2344/D 2344M.

2.1.2.2 Density

ASTM D 6111.

2.1.2.3 Compressive Strength

a. Secant Modulus: Minimum 70,000 psi in accordance with ASTM D 6108.

b. Stress at 3% strain: Minimum 1,500 psi in accordance with ASTM D 6108.

c. Compression Parallel to Grain: Minimum 3,000 psi in accordance with ASTM D 6112.

d. Compression Perpendicular to Grain: Minimum 1,000 psi in accordance with ASTM D 6112.

2.1.2.4 Flexural Strength

Minimum 2,000 psi in accordance with ASTM D 6109.

2.1.2.5 Tensile Strength

Minimum 1,250 psi in accordance with ASTM D 198.

2.1.2.6 Coefficient of Thermal Expansion

Maximum 0.000080 in/in/degree F in accordance with ASTM D 696.

2.1.2.7 Screw Withdrawal

350 lbs in accordance with ASTM D 6117.

2.1.2.8 Nail Withdrawal

150 lbs in accordance with ASTM D 6117.

2.2 LUMBER

2.2.1 Structural Lumber

Except where a specific grade is indicated or specified, any of the species and grades listed in AF&PA T101 that have allowable unit stresses in pounds per square inch (psi) not less than allowable unit stresses indicated. Use for joists, rafters, headers, trusses, beams (except collar beams), columns, posts, stair stringers, girders, and all other members indicated to be stress rated. Structural lumber exposed to view shall be appearance grade of any species meeting the allowable unit stresses indicated. Design of members and fastenings shall conform to AITC OT-01. Other stress graded or dimensioned items such as blocking, carriages, and studs shall be standard or No. 2 grade except that studs may be Stud grade.

2.2.2 Framing Lumber

Framing lumber such as studs, plates, caps, collar beams, cant strips, bucks, sleepers, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing shall be one of the species listed in the table below. Minimum grade of species shall be as listed.

Table of Grades for Framing and Board Lumber

Grading Rules	Species	Framing	Board Lumber
WWPA G-5 standard grading rules	Aspen Douglas Fir-Larch Douglas Fir South Engelmann Spruce -Lodgepole Pine Engelmann Spruce Hem-Fir Idaho White Pine Lodgepole Pine Mountain Hemlock Mountain Hemlock -Hem-Fir Ponderosa Pine -Sugar Pine Ponderosa Pine -Lodgepole Pine Subalpine Fir White Woods Western Woods Western Cedars Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common
WCLIB 17 standard grading rules	Douglas Fir-Larch Hem-Fir Mountain Hemlock Sitka Spruce Western Cedars Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: Standard
SPIB 1003 standard grading rules	Southern Pine	Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	No. 2 Boards
SCMA Spec standard specifications	Cypress	No. 2 Common	No. 2 Common
NELMA Grading Rules standard grading rules	Balsam Fir Eastern Hemlock -Tamarack Eastern Spruce Eastern White Pine Northern Pine Northern Pine Cedar	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common except Standard for Eastern White and Northern Pine
RIS Grade Use	Redwood	All Species:	Construction

Table of Grades for Framing and Board Lumber

Grading Rules	Species	Framing	Board Lumber
standard specifications		Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	Heart
NHLA Rules rules for the measurement and inspection of hardwood and cypress lumber	Cypress	No. 2 Dimension	No. 2 Common

2.2.3 Structural Glued Laminated Timber

AITC A190.1, allowable working stress values for loads of normal duration in pounds per square inch (psi) not less than indicated:

Fabricated with wet-use adhesives. Beams shall use glue-laminated and FSC-certified lumber. Posts and studs shall use laminated-strand lumber. Members shall be Industrial Appearance Grade, sealed with a penetrating sealer, and individually wrapped as standard with the manufacturer and approved. Members shall be complete with hardware for joining laminated members and for their connection to other construction.

2.3 PLYWOOD, STRUCTURAL-USE, AND ORIENTED STRAND BOARD (OSB) PANELS

APA PS 1, APA PS 2, APA E445S, and APA F405L respectively.

2.3.1 Subflooring

2.3.1.1 Plywood

C-D Grade, Exposure 1 durability classification, Span rating of 24/16, 48/24 or greater. FSC-certified.

2.3.1.2 Structural-Use and OSB Panels

Sheathing grade with durability equivalent to Exposure 1, Span Rating of 32/16 or greater. OSB, APA E445S, Rated Sturd-I-Floor. FSC-certified.

2.3.2 Combination Subfloor-Underlayment

2.3.2.1 Plywood

Underlayment Grade, Exposure 1, or Exterior Type, C-C (Plugged) Grade. Minimum thickness shall be as listed below except where indicated to have greater thickness.

Support Spacing	Underlayment Minimum Thickness
16 inches	1/2 inch for Group 1 species 19/32 inch for Group 2 and 3 species 23/32 inch for Group 4 species
24 inches	23/32 inch for Group 1 species 7/8 inch for Group 2 and 3 species one inch for Group 4 species

2.3.2.2 Structural-Use Panel

Combination subfloor-underlayment grade with durability equivalent to Interior plywood with Exterior glue (Exposure 1) or Exterior plywood, Span Rating of 24 or greater.

2.3.3 Wall Sheathing

2.3.3.1 Plywood

C-D Grade, Exposure 1, and a minimum thickness of 1/2 inch, except where indicated to have greater thickness. Provide exterior grade particleboard with phenol resin for interior and exterior applications.

2.3.3.2 Structural-Use and OSB Panels

Sheathing grade with durability equivalent to Exposure 1, Span Rating of 24/0 or greater. OSB, APA Rated Sheathing. OSB shall be a phenolic-glued, low-formaldehyde board.

2.3.4 Roof Sheathing

2.3.4.1 Plywood

C-D Grade, Exposure 1, with an Identification Index of not less than 24/0. Provide exterior grade particleboard with phenol resin for interior and exterior applications.

2.3.4.2 Structural-Use Panel

Sheathing grade with durability equivalent to Exposure 1, Span Rating of 24/0 or greater.

2.3.5 Diaphragms

2.3.5.1 Plywood

Structural I, Structural II, C-C, C-D grade, Exposure 1, and a minimum thickness of 1/2 inch.

2.3.5.2 Structural-Use and OSB Panels

Sheathing grade with durability equivalent to Exposure 1 and a minimum thickness of 1/2 inch.

2.3.6 Shear Walls

2.3.6.1 Plywood

Structural I, Structural II, C-C C-D Grade and a minimum thickness of 1/2 inch.

2.3.6.2 Structural-Use and OSB Panels

Sheathing grade with durability equivalent to Interior plywood with Exterior glue (Exposure 1) and a minimum thickness of 1/2 inch.

2.4 UNDERLAYMENT

Underlayment shall conform to one of the following:

2.4.1 Hardboard

AHA A135.4 service class, sanded one side, 1/4 inch thick, 4 feet wide.

2.4.2 Plywood

Plywood shall conform to APA PS 1, underlayment grade with exterior glue, or C-C (Plugged) exterior grade 11/32 inch thick, 4 feet wide.

2.4.3 Oriented Strand Board

OSB underlayment grade 0.225 inch.

2.5 OTHER MATERIALS

2.5.1 Hardboard Underlayment

PS-58, service class, sanded on one side, 1/4 inch thick 4 feet wide.

2.5.2 Building Paper

FS UU-B-790, Type I, Grade D, Style 1.

2.5.3 Trussed Rafters

Metal plate connected trusses designed in accordance with TPI 1 and TPI HIB and fabricated in accordance with TPI 1.

2.5.4 Trussed Joists

Metal plate connected parallel chord wood trusses designed and fabricated in accordance with TPI 1.

2.5.5 Miscellaneous Wood Members

2.5.5.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
Bridging	1 x 3 or 1 x 4 for use between members 2 x 12 and smaller; 2 x 4 for use between members larger than 2 x 12.
Corner bracing	1 x 4.
Furring	1 x 2, 3.
Grounds	Plaster thickness by 1-1/2.
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.5.5.2 Wood Bumpers

FS MM-T-371, Type I, Form A or B, and shall be oak.

2.5.5.3 Sill Plates

Sill plates shall be standard or number 2 grade.

2.5.5.4 Blocking

Blocking shall be standard or number 2 grade.

2.5.5.5 Rough Bucks and Frames

Rough bucks and frames shall be straight standard or number 2 grade.

2.5.6 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials, GS-36, SCAQMD Rule 1168, and as specified. Interior adhesives, sealants, primers and sealants used as filler must meet the requirements of LEED low emitting materials credit.

2.6 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be zinc-coated. Nails and fastenings for fire-retardant treated lumber and woodwork exposed to the weather shall be copper alloy.

2.6.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M, ASME B18.2.2, and ASTM A 687.

2.6.2 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.6.3 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices shall be 3/8 inch.

2.6.4 Lag Screws and Lag Bolts

ASME B18.2.1.

2.6.5 Toggle Bolts

FS FF-B-588.

2.6.6 Wood Screws

ASME B18.6.1.

2.6.7 Nails

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T10. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T101. Reasonable judgment backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.6.8 Wire Nails

ASTM F 1667.

2.6.9 Tacks

FS FF-T-1813.

2.6.10 Timber Connectors

Unless otherwise specified, timber connectors shall be in accordance with TPI 1, APA EWS T300E or AITC OT-01.

2.6.11 Clip Angles

Steel, 3/16 inch thick, size as indicated, best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.6.12 Joist Hangers

Steel or iron, zinc coated, sized to fit the supported member, of sufficient strength to develop the full strength of the supported member in accordance with ICC IBC, and furnished complete with any special nails required.

2.6.13 Tie Straps

For joists supported by the lower flange of steel beams, provide 1/8 by 1 1/2 inch steel strap, 2 feet long, except as indicated otherwise.

2.6.14 Joist Anchors

For joists supported by masonry walls, provide anchors 3/16 by 1 1/2 inch steel tee or strap, bent and of length to provide 4 inches embedment into wall and 12 inches along joist except as indicated otherwise. For joists parallel to masonry or concrete walls, provide anchors 1/4 by 1 1/4 inch minimum cross-sectional area, steel strap, length as necessary to extend over top of first three joists and into wall 4, 8 inches, and with wall end of bend or pin type, except as indicated otherwise.

2.6.15 Door Buck Anchors

Metal anchors, 1/8 by 1 1/4 inch steel, 12 inches long, with ends bent 2 inches, except as indicated otherwise. Anchors shall be screwed to the backs of bucks and built into masonry or concrete. Locate 8 inches above sills and below heads and not more than 24 inches intermediately between. Anchorage of bucks to steel framing shall be as indicated, as necessary to suit the conditions.

2.6.16 Metal Bridging

Where not indicated or specified otherwise, No. 16 U.S. Standard gage, cadmium-plated or zinc-coated.

2.6.17 Toothed Rings and Shear Plates

AF&PA T101.

2.6.18 Beam Anchors

Steel U-shaped strap anchors 1/4 inch thick by 1 1/2 inches wide, except as indicated otherwise.

2.6.19 Metal Framing Anchors

Construct anchors to the configuration shown using hot dip zinc-coated steel conforming to ASTM A 653/A 653M, G90. Except where otherwise shown, Steel shall be not lighter than 18 gage. Special nails supplied by the manufacturer shall be used for all nailing.

2.6.20 Panel Edge Clips

Extruded aluminum or galvanized steel, H-shaped clips to prevent differential deflection of roof sheathing.

2.7 AIR INFILTRATION BARRIER

Air infiltration barrier shall be building paper meeting the requirements of ASTM C 1136, Type IV, style optional or a tear and puncture resistant olefin building wrap (polyethylene or polypropylene) with a moisture vapor transmission rate of 125 g per square meter per 24 hours in accordance with ASTM E 96/E 96M, Desiccant Method at 23 degrees C or with a moisture vapor transmission rate of 670 g per square meter per 24 hours in accordance with ASTM E 96/E 96M, Water Method at 23 degrees C.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to AF&PA T10 and install in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value Engineering, unless otherwise indicated or specified. Select lumber sizes to minimize waste. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Space plastic lumber boards as necessary to allow for lengthwise expansion and contraction. Do not splice framing members between bearing points. Set joists, rafters, and purlins with their crown edge up. Frame members for the passage of pipes, conduits, and ducts. Provide adequate support as appropriate to the application, climate, and modulus of elasticity of the product. Do not cut or bore structural members for the passage of ducts or pipes without approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise shall be in accordance with the Nailing Schedule contained in ICC IBC; perform bolting in an approved manner. Spikes, nails, and bolts shall be drawn up tight. Install plastic lumber with screws or bolts; if nails are used, use ring shank or spiral shank nails. Timber connections and fastenings shall conform to AF&PA T101. Provide 2 inch minimum clearance between chimneys and wood framing; provide 4 inch minimum clearance at fireplaces. Fill the spaces with strips of approved noncombustible material. Use slate or steel shims when leveling joists, beams, and girders on masonry or concrete. Do not use shimming on wood or metal bearings. When joists, beams, and girders are placed on masonry or concrete, a wood base plate shall be positioned and leveled with grout. The joist, beam, or girder shall then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket shall be formed into the wall. The joist, beam, or girder shall then be placed into the pocket and leveled with a steel shim.

3.1.1 Sills

Set sills level and square and wedge with steel or slate shims; point or grout with non-shrinking cement mortar to provide continuous and solid bearing. Anchor sills to the foundations as indicated. Where sizes and spacing of anchor bolts are not indicated, provide not less than 5/8 inch diameter bolts at all corners and splices and space at a maximum of 6 feet o.c. between corner bolts. Provide at least two bolts for each sill member. Lap and splice sills at corners and bolt through the laps or butt the ends and through-bolt not more than 6 inches from the ends. Provide bolts with plate washers and nuts. Bolts in exterior walls shall be zinc-coated.

3.1.1.1 Anchors in Masonry

Except where indicated otherwise, embed anchor bolts not less than 15 inches in masonry unit walls and provide each with a nut and a 2 inch diameter washer at bottom end. Fully grout bolts with mortar.

3.1.1.2 Anchors in Concrete

Except where indicated otherwise, embed anchor bolts not less than 8 inches in poured concrete walls and provide each with a nut and a 2 inch diameter washer at bottom end. A bent end may be substituted for the nut and washer; bend shall be not less than 90 degrees. Powder-actuated fasteners spaced 3 feet o.c. may be provided in lieu of bolts for single thickness plates on concrete.

3.1.2 Beams and Girders

Set beams and girders level and in alignment and anchor to bearing walls, piers, or supports with U-shaped steel strap anchors. Embed anchors in concrete or masonry at each bearing and through-bolt to the beams or girders with not less than two bolts. Provide bolts not less than 1/2 inch in diameter and with plate washers under heads and nuts. Install beams and girders not indicated otherwise with 8 inch minimum end bearing on walls or supports. Install beams and girders into walls with 1/2 inch clearance at the top, end, and sides. Provide joints and splices over bearings only and bolt or spike together.

3.1.3 Roof Framing or Rafters

Tops of supports or rafters shall form a true plane. Valley, ridge, and hip members shall be of depth equal to cut on rafters where practicable, but in no case less than depth of rafters and nominally 2 inches thick. Rafters shall have full and solid bearing on plates. Valleys, hips, and ridges shall be straight and true intersections of roof planes. Necessary crickets and watersheds shall be formed. Rafters, except hip and valley rafters, shall be spiked to wall plate and to ceiling joists with no less than three 8-penny nails. Rafters shall be toe-nailed to ridge, valley, or hip members with at least three 8-penny nails. Rafters shall be braced to prevent movement until permanent bracing, decking or sheathing is installed. Hip and valley rafters shall be secured to wall plates by clip angles. Openings in roof shall be framed with headers and trimmers. Unless otherwise indicated, headers carrying more than two rafters and trimmers supporting headers carrying more than one rafter shall be double. Hip rafters longer than the available lumber shall be butt jointed and scabbed. Valley rafters longer than the available lumber shall be double, with pieces lapped not less than 4 feet and well spiked together. Trussed rafters shall be installed in accordance with TPI HIB. Engineered wood joists shall be installed in accordance with distributor's instructions.

3.1.4 Joists

Provide joists of the sizes and spacing indicated, accurately and in alignment, and of uniform width. Joists shall have full bearing on sills, plates, beams, girders, and trusses; provide laps over bearing only and spike. Where joists are of insufficient length to produce a 12 inch lap, butt joists over bearing and provide wood scabs 2 nominal inches thick by depth of joists by 24 inches long or metal straps 1/4 by 1 1/2 inch by not less than 18 inches long nailed to each joist with not less than four 10-penny nails, or approved sheet metal connectors installed in accordance

with the manufacturer's recommendations. Provide joists built into masonry with a beveled fire cut so that the top of the joist does not enter the wall more than one inch. Provide metal hangers for joists framing into the side of headers, beams, or girders. When a portion of the joist extends above the top flange of a steel beam or girder, provide a 3/8 inch space between the top flange and the extended portion of the joists to allow for shrinkage of joists. The minimum joist end bearing shall be 4 inches, and joists built into concrete or masonry shall have a 1/2 inch minimum clearance at the top, end, and sides. For joists approved to be bored for the passage of pipes or conduits, bore through the neutral axis of the joist. Provide steel joist hangers of proper size and type to receive the ends of all framed joists.

3.1.4.1 Floor (Ceiling) Framing

Except where otherwise indicated joists shall have bearings not less than 4 inches on concrete or masonry and 1-1/2 inches on wood or metal. Joists, trimmers, headers, and beams framing into carrying members at the same relative levels shall be carried on joist hangers. Joists shall be lapped and spiked together at bearings or butted end-to-end with scab ties at joint and spiked to plates. Openings in floors shall be framed with headers and trimmers. Headers carrying more than two tail joists and trimmers supporting headers carrying more than one tail joist shall be doubled, unless otherwise indicated. Joists built into masonry shall be provided with a beveled fire cut so that the top of the joist does not enter the wall more than 1 inch. Engineered wood joists shall be installed in accordance with distributor's instructions.

3.1.4.2 Doubled Joists

Provide under bearing walls and partitions running parallel with the floor joists, around stairways, chimneys, fireplaces, and at other openings where joists are cut and framed. Double, space for clearance, block apart 4 feet on center, rigidly frame, and spike together joists under partitions that are to receive ducts, pipes, and conduits.

3.1.4.3 Tie Straps

For joists supported by the lower flange of steel beams, provide straps at every fourth joist and the corresponding fourth joist on the opposite side. Tie joists across the top of the steel beam with a steel strap. Form straps to lie flat across the top of the beam and twist at the ends to provide flat contact with the side of each joist. Nail each strap at each end with three 10-penny nails spaced 2 inches o.c.

3.1.4.4 Joist Anchors

Provide anchors for each fourth joist supported by a masonry wall. Build wall end of anchors into the wall. Nail anchor to the joist with three 10-penny nails spaced 2 inches o.c. Anchor the first three joists parallel to concrete or masonry walls at bridging points, but not less than 8 feet o.c. from end walls. Let anchors into the tops of each joist and spike to the top of joist with one 10-penny nail. Extend anchors at least 4, 8 inches into the wall.

3.1.5 Bridging

Provide bridging for floor and ceiling joists and for roof rafters having slopes of less than 1/3. Locate bridging as indicated and as specified

herein. Provide bridging for spans greater than 6 feet, but do not exceed 8 feet maximum spacing between rows of bridging. Install rows of bridging uniformly. Provide metal or wood cross-bridging, except where solid bridging is indicated. Do not nail the bottom end of cross-bridging until the subfloor has been laid.

3.1.5.1 Metal Cross-Bridging

Shall be the manufacturer's standard product, not less than 16 gage before forming and coating. Metal bridging shall be the compression type, lodged into or nailed to the wide faces of opposite joists at points diagonally across from each other near the bottoms and tops of joists.

3.1.6 Subflooring

3.1.6.1 Plywood, Structural-Use, and OSB Panels

Apply best side up with the grain of outer plies or the long dimension at right angles to joists. Stagger end joints and locate over the centerline of joists. Support panel edges by nominal 2 by 4 members framed between joists so the edge joints of subfloor occur over the centerline of blocking. Allow 1/8 inch spacing at panel ends and 1/4 inch at panel edges. Panels shall be continuous over two or more spans. Nail panels 6 inches o.c. at supported edges and 10 inches o.c. over intermediate bearing. Nails shall be 8-penny common or 6-penny threaded. Provide at least 1/2 inch clearance between subflooring and masonry or concrete walls. Subflooring may be installed with adhesive conforming to ASTM D 3498 and nails spaced at 12 inches on center unless otherwise shown.

3.1.6.2 Combination Subfloor-Underlayment

Apply with the grain of the face plies or the long dimension at right angles to joists. Panels shall be continuous over two or more spans. Stagger end joints of adjacent panels. Panel edges shall be T&G or supported by 2 by 4 members framed between joists so the edge joints of subfloor-underlayment occur over the centerline of blocking. Provide end joints of panels over the centerline of joists. Allow 1/8 inch spacing between panel edge and end joints. Nail panels 6 inches o.c. at ends and edges and 10 inches o.c. along intermediate bearings unless they are glue-nailed in accordance with APA E30. Nails shall be 8-penny coated common or 6-penny threaded. Provide at least 1/2 inch clearance between subfloor-underlayment and masonry or concrete walls. Lightly sand all joints to receive resilient flooring.

3.1.6.3 Wood

Subflooring shall be applied diagonally with end joints made over supports. Each board shall bear on at least three supports and shall be nailed at each support using two nails for boards 6 inches and less in width and three nails for boards more than 6 inches in width.

3.1.6.4 Depressed Subfloors

Provide depressed subfloors to receive ceramic and quarry tile floors. Nail cleats or ledgers of one by four material to the sides of joists to support the flooring material. Place the cleats at a depth below the top of the joists sufficient to allow the installation of the subflooring below the tops of joists. Snugly fit subflooring as specified herein between joists.

3.1.7 Underlayment

Install underlayment over subfloor just prior to laying of resilient flooring and protect from water and physical damage. Underlayment shall be plywood. Stagger end joints of underlayment with respect to each other, and stagger all joints with respect to paralleling panel joints in subfloor. Space panels 1/16 inch apart at ends and 1/8 inch apart at edges and at least 1/2 inch from concrete or masonry walls. Nail panels 6 inches o.c. along edges and 6 inches o.c. each way throughout panel, but not closer than 3/8 inch to panel edges. Nails shall be 4-penny annular ring or screw type and shall be countersunk 1/16 inch. Lightly sand all joints to receive resilient flooring.

3.1.8 Columns and Posts

Set columns and posts, plumb, in alignment, and with full and uniform bearing. Do not embed the bottom and bearing surfaces of posts, columns, in concrete or set in direct contact with concrete slabs on grade. Provide post and beam construction with wood bolsters, steel post caps, in such a manner that the post above will tier directly over the one below; fabricate the assembly in a rigid and substantial manner using bolts or lag screws.

3.1.9 Wall Framing

3.1.9.1 Studs

Select studs for straightness and set plumb, true, and in alignment. In walls and partitions more than eight feet tall, provide horizontal bridging at not more than 8 feet o.c. using nominal 2 inch material of the same width as the studs; install the bridging flat. Sizes and spacing of studs shall be 16. Double studs at jambs and heads of openings and triple at corners to form corner posts. Frame corner posts to receive sheathing, lath, and interior finish. Truss over openings exceeding 4 feet in width or use a header of sufficient depth. Toe-nail studs to sills or sole plates with four 8-penny nails or fasten with metal nailing clips or connectors. Anchor studs abutting concrete or masonry walls thereto near the top and bottom and at midheight of each story using expansion bolts or powder-actuated drive studs.

3.1.9.2 Plates

Use plates for walls and partitions of the same width as the studs to form continuous horizontal ties. Splice single plates; stagger the ends of double plates. Double top plates in walls and bearing partitions, built up of two nominal 2 inch thick members. Top plates for nonbearing partitions shall be single or double plates of the same size as the studs. Nail lower members of double top plates and single top plates to each stud and corner post with two 16-penny nails. Nail the upper members of double plates to the lower members with 10-penny nails, two near each end, and stagger 16 inches o.c. intermediately between. Nail sole plates on wood construction through the subfloor to each joist and header; stagger nails. Anchor sole plates on concrete with expansion bolts, one near each end and at not more than 6 feet o.c., or with powder-actuated fasteners, one near each end and at not more than 3 feet o.c. Provide plates cut for the passage of pipes or ducts with a steel angle as a tie for the plate and bearing for joist.

3.1.9.3 Firestops

Provide firestops for wood framed walls and partitions and for furred spaces of concrete or masonry walls at each floor level and at the ceiling line in the top story. Where firestops are not automatically provided by the framing system used, they shall be formed of closely fitted wood blocks of nominal 2 inch thick material of the same width as the studs and joists.

3.1.9.4 Diagonal Bracing

Provide diagonal bracing at all external corners and internal angles and at maximum 40 foot centers in stud walls, except that bracing may be omitted where diagonally applied wood sheathing, plywood or structural-use panel sheathing, 4 by 8 foot fiberboard sheathing, or gypsum board sheathing is used. Bracing shall be of 1 by 6 material, let into the exterior face of studs. Extend bracing from top plates to sill at an angle of approximately 45 degrees and double nail at each stud. When openings occur near corners, provide diagonal knee braces extending from the corner post above headers to top plates and from below window sills to the main sill. Nail bracing at each bearing with two 8-penny nails.

3.1.10 Wall Sheathing

3.1.10.1 Plywood, Structural-Use, and OSB Panel Wall Sheathing

Apply horizontally or vertically. Extend sheathing over and nail to sill and top plate. Abut sheathing edges over centerlines of supports. Allow 1/8 inch spacing between panels and 1/8 inch at windows and doors. If sheathing is applied horizontally, stagger vertical end joints. Nail panels with 6-penny nails spaced 6 inches o.c. along edges of the panel and 12 inches o.c. over intermediate supports. Keep nails 3/8 inches away from panel ledges. Provide 2 by 4 blocking for horizontal edges not otherwise supported.

3.1.10.2 Fiberboard Wall Sheathing

Apply fiberboard wall sheathing allowing a 1/8 inch joint at edges to permit expansion, except at frames and openings where sheathing shall be fitted snugly. Pre-expand sheathing before application, allowing sheathing to condition for humidity as recommended by the sheathing manufacturer. Provide 2 by 4 blocking for horizontal edges not otherwise supported.

a. Fiberboard wall sheathing used with diagonal-braced framing shall be either 2 or 4 feet wide. Sheathing 2 feet wide shall have T&G or shiplapped edges and shall be applied horizontally with vertical joints staggered. Apply sheathing with tongued edge up and nail at edges and intermediate bearings with 1 3/4 inch long, zinc-coated steel roofing nails spaced on maximum 4 1/2 inch centers. Apply sheathing 4 feet wide either horizontally or vertically. Nail sheathing with 1 3/4 inch long, zinc-coated steel roofing nails spaced 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

b. Fiberboard wall sheathing used with unbraced framing shall be 4 feet wide. Apply sheathing vertically. Extend sheathing over and nail to sill and top plates. Locate joints over centerlines of supports. Nail sheathing with 1 1/2 inch long, zinc-coated steel roofing nails with 3/8 inch diameter heads. Space nails 3 inches o.c. at edges and ends and 6 inches o.c. at intermediate bearings.

3.1.10.3 Gypsum Sheathing Board

Apply gypsum sheathing board either horizontally or vertically. Butt joints and locate over the centerlines of supports. Horizontally applied sheathing shall be T&G, applied with tongued edge up. Stagger vertical joints and abut sheet closely to frames of openings. Nail sheathing with 11 gage, 3/8 inch head, zinc-coated nails 1 1/2 inches long for 1/2 inch sheathing and 1 3/4 inches long for 5/8 inch sheathing, spaced 3/8 inch minimum from edges. Provide 2 by 4 blocking for horizontal edges of 4 foot wide panels not otherwise supported.

a. Gypsum Sheathing Board Used with Diagonal-Braced Framing: Sheathing shall be either 2 or 4 feet wide. Apply sheathing 2 feet wide horizontally. Nail 4 inches maximum o.c. at edges and over intermediate bearings. Apply sheathing 4 feet wide either horizontally or vertically. Nail 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

b. Gypsum Sheathing Board Used with Unbraced Frames: Sheathing shall be 4 feet wide and applied vertically. Extend sheathing over and nail to both sill and top plates. Nail 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

3.1.11 Wood Sheathing

Sheathing end joints shall be made over framing members and so alternated that there will be at least two boards between joints on the same support. Each board shall bear on at least three supports. Boards shall be nailed at each support using two nails for boards 6 inches and less in width and three nails for boards more than 6 inches in width. Roof sheathing shall not be installed where roof decking is installed.

3.1.12 Building Paper

Provide building paper where indicated. Apply paper shingle fashion, horizontally, beginning at the bottom of the wall. Lap edges 4 inches, and nail with one inch, zinc-coated roofing nails, spaced 12 inches o.c. and driven through plastic discs.

3.1.13 Ceiling Joists

Size as indicated and set accurately and in alignment. Toe-nail joists to all plates with not less than three 10-penny nails. Frame openings in ceilings with headers and trimmers.

3.1.14 Metal Framing Anchors

Provide framing anchors at every other rafter or trussed rafter to fasten rafter or trussed rafter to plates and studs against uplift movement and forces as indicated. Anchors shall be punched and formed for nailing so that nails will be stressed in shear only. Nails shall be zinc-coated; drive a nail in each nail hole provided in the anchor.

3.1.15 Trusses

Metal plate connected wood trusses shall be handled, erected, and braced in accordance with TPI HIB and as indicated.

3.1.16 Structural Glued Laminated Timber Members

Brace members before erection. Align members and complete all connections before removal of bracing. Unwrap individually wrapped members only after adequate protection by a roof or other cover has been provided. Treat scratches and abrasions of factory applied sealer with two brush coats of the same sealer used at the factory.

3.1.17 Plywood and Structural-Use Panel Roof Sheathing

Install with the grain of the outer plies or long dimension at right angles to supports. Stagger end joints and locate over the centerlines of supports. Allow 1/8 inch spacing at panel ends and 1/4 inch at panel edges. Nail panels with 8-penny common nails or 6-penny annular rings or screw-type nails spaced 6 inches o.c. at supported edges and 12 inches o.c. at intermediate bearings. Do not use staples in roof sheathing. Where the support spacing exceeds the maximum span for an unsupported edge, provide adequate blocking, tongue-and-groove edges, or panel edge clips, in accordance with APA E30.

3.1.18 Stair Framing

Cut carriages to exact shape required to receive treads and risers, with risers of uniform height and treads of uniform width. Provide trimmers, nailers, and blocking as required to support finish materials.

3.1.19 Plastic Lumber

In conjunction with above requirements, follow manufacturer's recommendations for plastic lumber installation, including requirements for structural support, thermal movement, working, fastening, and finishing. Use standard woodworking tools, including carbide tips, coarse saw blades, and routers with aggressive cutters. Follow manufacturer's recommendations for repair by melting.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.1.1 Roof Nailing Strips

Provide roof nailing strips for roof decks as indicated and specified herein. Apply nailing strips in straight parallel rows in the direction and spacing indicated. Strips shall be surface applied.

a. Surface-Applied Nailers: Shall be 3 inches wide and of thickness to finish flush with the top of the insulation. Anchor strips securely to the roof deck with powder actuated fastening devices or expansion shields and bolts, spaced not more than 24 inches o.c. On decks with slopes of one inch or more, provide surface applied wood nailers for securing insulation and for nailing of roofing felts.

b. Embedded Nailers: Shall be nominal 2 by 3 with 2 inch sides beveled. Set and anchor nailers to finish flush with the roof deck surface.

3.2.1.2 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers shall be 6 inches wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM DS 1-49. Strips shall be grooved as indicated for edge venting; install at walls, curbs, and other vertical surfaces with a 1/4 to 1/2 inch air space.

3.2.1.3 Crickets, Cants, and Curbs

Provide wood saddles or crickets, cant strips, curbs for scuttles and ventilators, and wood nailers bolted to tops of concrete or masonry curb and at expansion joints, as indicated, specified, or necessary and of lumber 1/2 inch thick exterior plywood.

3.2.2 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.3 Wood Grounds

Provide for fastening wood trim, finish materials, and other items to plastered walls and ceilings. Install grounds in proper alignment and true with an 8 foot straightedge.

3.2.4 Wood Furring

Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips shall be nominal one by 3, continuous, and spaced 16 inches o.c. Erect furring vertically or horizontally as necessary. Nail furring strips to masonry. Do not use wood plugs. Provide furring strips around openings, behind bases, and at angles and corners. Furring shall be plumb, rigid, and level and shall be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required. Form furring for cornices, offsets and breaks in walls or ceilings on 1 by 4 wood strips spaced 16 inches o.c.

3.2.5 Wood Bumpers

Dress to the sizes indicated, and bevel edges. Bore, countersink, and bolt bumpers in place.

3.2.6 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

3.2.7 Wood Sleepers

Run wood sleepers in lengths as long as practicable and stagger end joints in adjacent rows.

3.2.8 Shear Walls

Install plywood or structural-use panels with long dimension parallel or perpendicular to supports. Provide blocking behind edges not located over supports. Nail panels with 8-penny nails spaced not more than 6 inches on centers along panel edges and 6 inches o.c. over intermediate bearings. Two rows 3-inch on center staggered on top and bottom edge.

3.2.9 Bridging

Wood bridging shall have ends accurately bevel-cut to afford firm contact and shall be nailed at each end with two nails. Metal bridging shall be installed as recommended by the manufacturer. The lower ends of bridging shall be driven up tight and secured after subflooring or roof sheathing has been laid and partition framing installed.

3.2.10 Corner Bracing

Corner bracing shall be installed when required by type of sheathing used or when siding, other than panel siding, is applied directly to studs. Corner bracing shall be let into the exterior surfaces of the studs at an angle of approximately 45 degrees, shall extend completely over wall plates, and shall be secured at each bearing with two nails.

3.2.11 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more than 6 feet on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece.

3.3 INSTALLATION OF TIMBER CONNECTORS

Installation of timber connectors shall conform to applicable requirements of AF&PA T101.

3.4 ERECTION TOLERANCES

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/4 inch in 8 feet from a straight line;

(3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/4 inch in 8 feet from a true plane.

b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

(1) Layout of walls and partitions: 1/4 inch from intended position;

(2) Plates and runners: 1/8 inch in 8 feet from a straight line;

(3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/8 in 8 feet from a true plane.

3.5 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

SECTION 06 17 00

PREFABRICATED WOOD TRUSSES

04/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 446	(1991) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Stone Sewer and Drainage Pipe

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB Rules	(1994; Supple 8 thru 11) Southern Grading Rules for Southern Pine Lumber

TRUSS PLATE INSTITUTE (TPI)

TPI 1	(1995; Errata) National Design Standard for Metal Plate-Connected Wood Truss Construction and Commentary; and Appendix 1
TPI Bklet HIB	(1991) Handling, Installing & Bracing Metal Plate Wood Trusses

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-N-105	(Rev. B; Am 3; Int Am 4; Notice 1) Nails, Brads, Staples, and Spikes, Wire Cut and Wrought
FS MM-L-751	(Rev. H) Lumber; Softwood

1.2 QUALITY ASSURANCE

1.2.1 Lumber Standards

Comply with FS MM-L-751 and the SPIB Rules Grading Rules, unless otherwise specified.

1.2.2 Grade Marks

All lumber shall be identified by the official grade mark including the symbol of the grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, and condition of seasoning at time of manufacture.

1.2.3 Assembled Truss

Shall conform to TPI standards.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Shop and Erection Drawings

SD-07 Certificates

Metal connector plates for wood truss joints: Submit manufacturer's complete descriptive literature

Prefabricated metal accessories: Submit manufacturer's complete descriptive literature

Certificates of conformance that wood truss members conform to the dimensions and quality requirements of the drawings, Specifications and the approved shop drawings

1.3.1 Detailed Shop and Erection Drawings for the Wood Trusses

Shall be submitted for review prior to the fabrication of wood trusses. Such drawings shall include the following minimum information:

a. Design and fabrication data. Include reference to design criteria used and stress computations.

b. Connector plate gage, size of plates, location of plates and manufacturer.

c. Lumber grades and species.

d. Span, dimensions and spacing of trusses.

e. Design loads, allowable unit stresses, stress increase and duration factors.

f. Dimensioned elevation of each truss indicating members, plates and configurations in conformance with the contract documents. Locate and detail prefabricated metal accessories and field connections.

g. Handling and erection instructions.

h. Bracing instructions during and after erection, bracing diagrams, details and sizes in addition to the minimum bracing shown on the Contract Drawings.

i. Name, registration number, state and seal of the Professional Engineer designing the truss.

The Contractor shall submit shop drawings for review prior to beginning fabrication.

1.3.2 The Shop and Erection Drawings Review

Will be for size and arrangement of the members and strength of connections only. The Contractor shall check dimensions and quantities and any errors shown on the shop drawings shall be the responsibility of the Contractor.

1.3.3 The Review

Shall not be construed as a waiver of construction responsibilities unless the Contractor has requested a deviation from the contract documents in writing and the Government has granted such deviation in writing. Fabrication or delivery of materials prior to review of the shop drawings shall be entirely at the risk of the Contractor.

1.4 PRODUCT HANDLING AND STORAGE

1.4.1 Handling

Prefabricated trusses shall not be carelessly unloaded from delivery vehicles, handled, or erected in such a manner as to alter the configuration of the trusses or permanently distort the individual members or connectors. The manufacturer's instructions shall be carefully followed.

1.4.2 Storage

Storage on the project site shall be at least 4 inches above the ground least 4 inches above the ground on platforms, skids or other supports and shall be covered with waterproof materials to prevent the exposure of the trusses to the elements.

1.4.3 Bearing Supports and Temporary Bracing

Shall be provided to avoid distortion or overturning of the trusses.

1.4.4 Accessories and Other Packaged Materials

Shall be stored off the ground in their original unbroken packages or containers and shall be protected from corrosion.

1.5 ALLOWABLE TOLERANCES

a. Toothed Connector Locations: 1/4 inch from location shown on shop drawings.

b. Length of Members:

1. Up to 20 feet: $\pm$ 1/16 inch.

2. Over 20 feet: $\pm$ 1/16 inch per 20 feet of specified length.

c. Square End Cuts Square within 1/16 inch per foot of depth and width.

1.5.1 Openings Between Members of Assembled Trusses

1.5.1.1 Tension Members

1/16 inch maximum.

1.5.1.2 Compression Members

1/32 inch maximum.

1.6 TRUSS DESIGN

1.6.1 The Contractor shall furnish the truss design.

The trusses shall be designed by the truss shop drawings and calculations sealed by a Professional Engineer.

1.6.2 Trusses

Shall be wood trusses with steel, toothed plate connectors, designed specifically for this project.

1.6.3 The Trusses

Trusses shall be designed to withstand the live loads, wind load, dead load of the structure and superimposed dead loads shown on the drawings at a maximum truss spacing of 2 feet - 0 inches.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Lumber for Wood Trusses

2.1.1.1 Sizes

Shall be as follows, unless otherwise shown:

Member	Size
Bridging members	1 by 3 or 1 by 4 for use between 2 by 12 and smaller; 2 by 4 for use between members larger than 2 by 12.
Corner Bracing	1 by 4.
Furring	1 by 2.
Grounds	Plaster thickness by 1-1/2.
Nailing Strips	1 by 3 or 1 by 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.1.1.2 Truss Members

Shall be kiln-dried, grade-marked, Southern Pine of the grades and dimensions indicated, or better.

2.1.1.3 Maximum Moisture Content

Maximum moisture content at surfacing and at time of use shall be 15%.

Minimum moisture content at time of fabrication shall be 7%.

2.1.2 Connector Plates for Wood Trusses

Connector Plates shall be 20 gage minimum thickness, galvanized steel conforming to ASTM A 446, Grade A, coating G60, conforming to TPI 1. Plates shall be manufactured with intergal teeth or prongs uniformly spaced and formed.

2.1.3 Nails

Shall conform to Federal Specification FS FF-N-105. Minimum size shall be 6d x 1-1/2 inches.

2.1.4 Prefabricated Metal Accessories

Prefabricated metal hangers, angles, strapes, anchors, plates and other anchors, plates and other accessories as shown or required for connection of wood framing or trusses shall be galvanized steel, 20 gage minimum thickness conforming to ASTM A 446, Grade A, coating G90, or equivalent.

PART 3 EXECUTION

3.1 WOOD TRUSS FABRICATION

Light-metal-plate-connected wood trusses shall be designed in conformance with TPI 1 and fabricated in conformance with TPI Bklet HIB. When new plate configuration is proposed, load testing of trusses is required and shall conform to Appendix D of TPI 1.

3.1.1 Cutting The Truss Members

Truss members shall be cut to accurate lengths, angles and sizes to assure tight joints for finished trusses.

3.1.2 Truss Members Assembly

Truss members shall be assembled in the design configurations by securing tightly in jigs or with clamps.

3.1.3 The Design Camber

Shall be included when positioning the truss members for fabrication.

3.1.4 Connecting Truss Members at Intersections

Truss members shall be properly connected at all intersections of members shown on the drawings and required for support of the framing. There is no allow able of looseness and separation of the connector plates.

3.2 ERECTION

3.2.1 Before Commencing Erection of Trusses

Check all governing commencing erection of trusses, check all governing measurements at the building and the levels of all bearing surfaces on which the members are to be supported, and any discrepancies shall be corrected before erection of the trusses is commenced.

3.2.2 All Surfaces to Receive Trusses

Shall be free of irregularities, dirt and debris.

3.2.3 Hoisting of Trusses

Hoist trusses into position with lifting cables positioned at the designated lifting points. For truss spans in excess of thirty feet, a spreader bar or strong-back shall be used. Hoisting shall minimize the out-of-plane bending of trusses.

3.2.4 Temporary Bracing, Cross Bracing, Shoring and Guying

Temporary bracing, cross bracing, shoring and guying of the trusses and framing against wind, construction loads and other temporary forces shall be adequate to hold the members plumb and properly aligned until such time as the permanent bracing is installed and the temporary protection is no longer required for the safe support of the trusses.

3.2.5 Permanent Bracing and Related Components

Shall be installed prior to application of loads to the trusses.

3.2.6 Construction Loads

Shall be limited to the safe capacity of the trusses to prevent overstressing of the truss members and connectors.

3.2.7 Truss Members or Connectors

Shall not be cut or removed from new or existing trusses.

3.2.8 Wood Trusses

Shall be provided with indicated bearing and uplift anchorage and required for the safe support of the framing. Prefabricated anchorage devices shall be nailed as recommended by the manufacturer to resist the design loads. Other framed connections shall be securely nailed with a minimum of 2-16d nails.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspection

Inspection of framing for proper dimensions, alignment, tightness of connectors, bracing and adequacy prior to the application of dead loads shall be provided by the contractor before final government field review.

3.3.2 Labor, Platforms, Ladders or Other Access

Labor, platforms, ladders or other access required for the Government to achieve proper field review of the work shall be provided by the Contractor.

3.3.3 Damaged Trusses

Shall be repaired or replaced.

-- End of Section --

SECTION 06 18 00

GLUE-LAMINATED CONSTRUCTION

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC 109	(1998) Standard for Preservative Treatment of Structural Glued Laminated Timber
AITC 110	(2001) Standard Appearance Grades for Structural Glued Laminated Timber
AITC 111	(2005) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection
AITC 113	(2001) Standard for Dimensions of Structural Glued Laminated Timber
AITC 117	(2004) Standard Specifications for Structural Glued Laminated Timber of Softwood Species, Design and Manufacturing Requirements
AITC 200	(2004) Inspection Manual

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1	(1965; R 2003) Plain Washers
ANSI B18.22M	(1981; R 2005) Metric Plain Washers

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA T1	(2004; R 2005) Use Category System: Processing and Treatment Standard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 283/A 283M	(2003; R 2007) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D 3737	(2007) Standard Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam)
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	(2002) Standard Grading Rules for Southern Pine Lumber

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-L-19140	(Rev E; Am 2) Lumber and Plywood, Fire-Retardant Treated

UNDERWRITERS LABORATORIES (UL)

UL 723	(2003; Rev thru May 2005) Standard for Test for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Fabrication Drawings and Installation Drawings in accordance with paragraph entitled, "Drawings," of this section.

SD-03 Product Data

Provide Manufacturer's Catalog Data in accordance with paragraph entitled, "Manufacturer's Information," of this section.

SD-04 Samples

Submit three samples of Exposed-to-View Surfaces in accordance with paragraph entitled, "Surfaces," of this section.

SD-07 Certificates

Submit Certificates for Glue-Laminated Structural Units in accordance with paragraph entitled, "Quality Control."

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for the following items in accordance with paragraph entitled, "Quality Control," of this section.

Laminated Wood Materials
Adhesive

1.3 FIELD MEASUREMENTS

Verify all field measurements prior to preparation of shop drawings (Fabrication Drawings and Installation Drawings) to ensure proper fitting of the work.

1.4 QUALIFICATIONS FOR LAMINATING WOOD MANUFACTURER

Laminated wood members manufacturer must be an approved firm licensed by the American Institute of Timber Construction to use the AITC Custom and/or Non-Custom Product Quality Mark and to issue the AITC certificate of conformance. Manufacture of the laminated timber shall meet the requirements of AITC 117 and ASTM D 3737.

1.5 DELIVERY, HANDLING, AND STORAGE

Deliver laminated wood structural members in such quantities and at such times as to ensure the continuity of the installation of structural members and maintenance of progress schedules.Refer to AITC 111.

Deliver packaged or wrapped materials in their original, undamaged wrapping, bearing label clearly identifying manufacturer's name, grade and species of lumber, type of glue, and other pertinent data. Use nonmarring slings for loading, unloading, and handling members to prevent damage to surfaces or wrapping.

Store wrapped materials in their original wrapping until ready for installation.

Place members on level supports off ground, spaced and braced to allow through ventilation. Cover wood and keep free of dirt, grease, moisture, or foreign matter that could cause staining.

1.6 DRAWINGS

Submit Fabrication Drawings for glue-laminated structural units consisting of fabrication and assembly details to be performed in the factory.

Provide Installation Drawings for glue-laminated structural units showing dimensions of laminated wood members, location, size, and type of reinforcement, including any reinforcement necessary for safe handling and erection of structural members. Identify each structural member and the corresponding sequence and procedure to be followed in installation, and location and details of anchorage devices that are to be embedded in other construction on layout drawings.

1.7 MANUFACTURER'S INFORMATION

Include Manufacturer's Catalog Data for erection procedure of laminated structural members, including the sequence of erection, temporary supports and bracing, and lifting and handling equipment.

Submit Manufacturer's Instructions for Laminated Wood Materials and Adhesive including special provisions required to install equipment components and system packages. Detail with special notices all impedances, hazards and safety precautions.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Lumber

Wood members shall be southern pine, graded by the same basic provisions as used for solid sawn lumber in SPIB 1003.

Wood species shall meet the structural requirements of ASTM D 3737, AITC 113, AITC 117 and applicable local codes.

Laminating lumber shall be kiln-dried and stress-graded to meet the requirements of AITC 117.

Lumber combination shall be determined by the design requirements for each component and designated on the shop drawings. AITC lumber combination symbols shall be used for this identification.

Laminated wood members shall have a maximum moisture content of 14-percent throughout the entire piece before surfacing and bonding.

Laminated wood shall be AITC Premium, Architectural, Industrial Grade and conform to standards as established in AITC 110.

2.1.2 Pressure and Fire-Retardant Treatment

Pressure impregnate fire-retardant treated wood by an approved process in accordance with AITC 109, and AWPA T1.

After pressure treatment, wood members shall have a UL flame spread rating not greater than 25. Wood shall show no evidence of progressive combustion when tested for 30 minutes in accordance with UL 723 and ASTM E 84.

Penetration of fire-retardant material of treated wood shall be in accordance with MIL-L-19140. Determine depth of penetration by borer cores taken from 20 pieces of each charge and tested. If 80 percent of the borings meet the penetration requirements, the charge will be accepted.

Identify approved fire retardant wood members with fire retardant rating, per AITC Technical Note 7 and as issued by an approved testing agency.

Kiln dry wood after treatment to remove the moisture injected during treatment yielding an average moisture content of not more than 19 percent.

2.1.3 Adhesive

Bond laminated members with a waterproof adhesive conforming to the test requirements of ASTM D 3737 for waterproof glue, shear strength and durability.

2.1.4 Finishes

Laminated wood shall receive one factory-applied coat of sealer to the ends

of members immediately after trimming. No other sealer shall be required.

Laminated-wood members shall be left unfinished after final surfacing and sanding.

2.1.5 Hardware

Contractor shall furnish metal shapes, plates, and bars needed for assembly and connection of members. Comply with ASTM F 568M.

Steel plates shall be hot-rolled carbon steel of structural quality, conforming to ASTM A 283/A 283M, Grade C.

Steel anchor bolts shall be low-carbon steel with regular hexagon nuts and carbon steel washers. Anchor bolts and nuts shall conform to ASTM A 307 ASTM F 568M.

Washers shall be plain washers conforming to ANSI B18.22.1 ANSI B18.22M.

Clean oil, dirt, rust, and foreign matter from all metal surfaces. For exterior locations, the hardware shall be hot-dipped galvanized in accordance with ASTM A 153/A 153M, with coating weight as required for Class A, B, C, or D material as described therein. Coat other metal surfaces with one coat of manufacturer's standard rust-resisting metal primer applied at a minimum dry-film thickness of 1.5 mils.

2.2 QUALITY CONTROL

Certificates for Glue-Laminated Structural Units shall include a laboratory report for the laminated wood and for the laminating adhesives as follows:

checking of moisture content
surfacing
temperature of lumber at time of gluing
adhesive mixing and spread
adhesive pressure and curing conditions during the manufacturing process

Include in report the results of tests, shear strength, and durability of the glue line. Comply with the requirements of ASTM D 3737. Material tested shall be typical of a production run of the same material to be used in the project. Tests shall be conducted within 6 months prior to delivery of the wood.

Provide Certification that structural members meet the requirements of ASTM D 3737 and AITC 200.

2.3 SURFACES

Submit three samples, 12-inches long by sufficient width and thickness to illustrate the quality and color of Exposed-to-View Surfaces.

PART 3 EXECUTION

3.1 INSTALLATION

Conform spacing and placement of members and installation methods as indicated and approved.

3.2 PROTECTION AGAINST MOISTURE LOSS

After installation, cover each member with a temporary waterproof protection to maintain the moisture content of the wood. Maintain protection until members are enclosed within the building and final coats are about to be applied. Elevate initial building heat gradually to the desired level. To minimize checking do not reduce the relative humidity of the building rapidly.

-- End of Section --

SECTION 06 20 00

FINISH CARPENTRY

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.6	(1998) Hardboard Siding

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20	(1970) American Softwood Lumber Standard

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C20	(2003) Structural Lumber Fire-Retardant Treatment by Pressure Processes
AWPA C27	(2002) Plywood - Fire-Retardant Treatment by Pressure Processes
AWPA C9	(2003) Plywood - Preservative Treatment by Pressure Processes
AWPA M2	(2001) Standard for Inspection of Treated Wood Products
AWPA M4	(2002) Standard for the Care of Preservative-Treated Wood Products

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E445S	(2001; R 2002) Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)
APA PS 1	(1995) Voluntary Product Standard for Construction and Industrial Plywood
APA PS 2	(2004) Voluntary Product Standard for Wood-Based Structural-Use Panels

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(8th Edition) AWI Quality Standards

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; Addenda A 1999; Errata 2003; R 2005) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts (Inch Series)
ASME B18.6.1	(1981; R 1997) Wood Screws (Inch Series)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 687	(1993) Standard Specification for High-Strength Nonheaded Steel Bolts and Studs
ASTM D 2898	(2007) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM F 547	(2006) Nails for Use with Wood and Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(2003) Cabinet Hardware

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1	(2002) Medium Density Fiberboard (MDF) For Interior Applications

HARDWOOD PLYWOOD & VENEER ASSOCIATION (HPVA)

HPVA HP-1	(2004) American National Standard for Hardwood and Decorative Plywood

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(2003) Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(2003) Standard Grading Rules for Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

RIS Grade Use (1998) Redwood Lumber Grades and Uses

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec (1986; Supple. No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003 (2002) Standard Grading Rules for Southern Pine Lumber

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (2000) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 (1998) Western Lumber Grading Rules

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 4 (2000) Water-Repellent Preservative Non-Pressure Treatment for Millwork

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

WMMPA WM 6 (1987) Industry Standard for Non-Pressure Treating of Wood Millwork

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Siding

Manufacturer's printed data, showing texture, density, catalog cuts, and installation instructions.

Wood Items, Siding, and Trim

Manufacturer's printed data indicating the usage of engineered or recycled wood products, and environmentally safe preservatives.

SD-04 Samples

Siding

Wood Shingles

Moldings

Fascias and Trim

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

SD-07 Certificates

Certificates of grade

Certificates of compliance

1.3 DETAIL DRAWINGS

The Contractor shall submit detail drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

1.4 CERTIFICATES

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

Provide certificates of compliance unless materials bear certification markings or statements.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver lumber, plywood, trim, and millwork to job site in an undamaged condition. Stack materials to ensure ventilation and drainage. Protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in building until wet trade materials are dry.

1.6 QUALITY ASSURANCE

1.6.1 Lumber

Identify each piece or each bundle of lumber, millwork, and trim by the grade mark of a recognized association or independent inspection agency that is certified by the Board of Review, American Lumber Standards Committee, to grade the species.

1.6.2 Plywood

Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of the plywood. Mark shall identify plywood by species group or span rating, and shall show exposure durability classification, grade, and compliance with APA PS 1.

1.6.3 Hardboard

Materials shall bear a marking or statement identifying the producer and the applicable standard.

1.6.4 Pressure-Treated Lumber and Plywood

Each treated piece shall be inspected in accordance with AWPA M2.

1.6.5 Nonpressure-Treated Woodwork and Millwork

Mark, stamp, or label, indicating compliance with WDMA I.S. 4.

1.6.6 Fire-Retardant Treated Lumber

Each piece to bear Underwriters Laboratories label or the label of another nationally recognized independent testing laboratory.

PART 2 PRODUCTS

2.1 WOOD

2.1.1 Sizes and Patterns of Wood Products

Yard and board lumber sizes shall conform to ALSC PS 20. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the applicable standard.

2.1.2 Trim, Finish, and Frames

Provide species and grades listed for materials to be paint finished. Provide materials that are to be stain, natural, or transparent finished one grade higher than that listed. Provide species indicated for materials to be transparent finished. Run trim, except window stools and aprons with hollow backs.

TABLE OF GRADES FOR WOOD TO RECEIVE PAINT FINISH

Grading Rules	Species	Exterior and Interior Trim, Finish, and Frames
WWPA G-5 grading rules	Aspen Douglas Fir-Larch Douglas Fir-South Engelmann Spruce -Lodgepole Pine Engelmann Spruce Hem-Fir Idaho White Pine Lodgepole Pine Mountain Hemlock Mountain Hemlock -Hem-Fir Ponderosa Pine-Sugar Pine (Ponderosa Pine -Lodgepole Pine)	All Species: C & Btr. Select (Choice & Btr Idaho White Pine) or Superior Finish. Western Red Cedar may be graded C & Btr. Select or A & Btr. per Special Western Red Cedar Rules.

TABLE OF GRADES FOR WOOD TO RECEIVE PAINT FINISH

Grading Rules	Species	Exterior and Interior Trim, Finish, and Frames
	White Woods (Western Woods) Western Cedars Western Hemlock	
WCLIB 17 standard grading rules	Douglas Fir-Larch Hem-Fir Mountain Hemlock Sitka Spruce Western Cedars Western Hemlock	All Species: C & Btr VG, except A for Western Red Cedar
SPIB 1003 grading rules	Southern Pine	C & Btr
SCMA Spec standard specification	Cypress	C-Select
NELMA Grading Rules standard grading rules	Balsam Fir Eastern Hemlock-Tamarack Eastern Spruce Eastern White Pine Norway Pine Northern Pine Northern White Cedar	All Species: C-Select except C & Btr for Eastern White Pine and Norway Pine
RIS Grade Use standard specifications	Redwood	Clear Clear All Heart
NHLA Rules rules	Cypress	B Finish
	Red Gum Soft Elm Birch	Select or Btr (for interior use only)

2.1.3 Utility Shelving

Utility shelving shall be a suitable species equal to or exceeding requirements of No. 3 Common white fir under WWPA G-5, 1 inch thick; or plywood, interior type, Grade A-B, 1/2 inch thick, any species group.

2.1.4 Softwood Plywood

APA PS 1, thicknesses as indicated.

a. Plywood for Soffits: Exterior type, B-B medium density overlay.

b. Plywood for Shelving: Interior type, A-B, B-B Grade, any species group.

c. Plywood for Countertops: Exterior type, A-C Grade.

2.1.5 Hardwood Plywood

HPVA HP-1, Type Premium (A) Grade, hardwood veneer core construction or lumber core construction.

2.1.6 Particleboard

CPA A208.1, Grade 1-M-2 or 2-M-2 or better.

2.1.7 Stairs

Treads 1 1/4 inches thickness, clear red or white oak. Risers one inch nominal finish lumber.

2.1.8 Shoe Mold

Clear red or white oak, 1/2 by 5/8 inch unless otherwise indicated.

2.1.9 Wood Seats

Clear maple, oak, or other suitable hardwood, not less than 1 5/8 inches thick, with rounded edges. Provide stainless steel stanchions or brackets as indicated.

2.1.10 Wood Bumpers

Clear oak, maple, birch, dressed to size indicated and with outer edges beveled.

2.1.11 Catwalks

Boards, one by 6 inches nominal, species and grade equal to or exceeding 3 Common Hem-Fir under WWPA G-5.

2.1.12 Siding

Horizontal siding shall be hardboard, plywood, or wood. Panel siding shall be hardboard or plywood.

2.1.12.1 Horizontal Hardboard Siding

AHA A135.6, factory primed face and longitudinal edges, factory sealed back, lap type, 8 inches wide, maximum practicable lengths, 3/8 or 7/16 inch thick, textured face.

2.1.12.2 Panel Hardboard Siding

AHA A135.6, factory primed face and longitudinal edges, factory sealed back, 4 feet wide, maximum practicable lengths, 3/8 or 7/16 inch thick, smooth, embossed, face, and grooved as selected from manufacturer's standard patterns.

2.1.12.3 Horizontal Plywood Siding

APA PS 1, exterior, medium-density overlay lap type, 6 inches wide, maximum practicable lengths, 15/32, 1/2 inch thick, rough-sawn texture face.

2.1.12.4 Panel Plywood Siding

APA PS 1, exterior, medium-density overlay, 4 feet wide, maximum practicable lengths, span rating of 16 oc, rough-sawn texture face, and grooved as selected from manufacturer's standard patterns.

2.1.12.5 Horizontal Rated Siding

Qualified under APA E445S, exterior type medium-density overlay, lap types, 6 inches wide, maximum practicable lengths, 15/32, 1/2 inch thick, rough-sawn texture face.

2.1.12.6 Panel Rated Siding

Qualified under APA E445S, exterior type, medium-density overlay 4 feet wide, maximum practicable lengths, span rated at 24 oc, striated face, and grooves as selected from manufacturer's standard patterns.

2.1.12.7 Wood Siding

Species and grades listed in paragraph entitled "Trim, Finish, and Frames" Table. Siding shall be horizontal bevel type, minimum 3/16 inch thin edge by minimum 7/16 inch thick edge, horizontal plain lap type horizontal drop type vertical board, tongue and groove or shiplap on long edges, vertical board and batten type, one inch thick, 6 inches wide, maximum practicable lengths, rough-sawn texture.

2.1.12.8 Wood Structural Panels

Wood Structural Panels shall conform to APA PS 2, exterior, exposure 1 or 2, single-faced, double-faced, 4 feet wide, maximum practicable lengths, selected from manufacturer's standard patterns to satisfy the wind load for the specified span.

2.2 SOFFITS

2.2.1 Hardboard and Plywood

Hardboard and plywood soffits shall be siding grade hardboard, 7/16 inch thick; plywood, APA PS 1, exterior type, Grade A-C, 15/32 inch thick for 24 inch on centers maximum span with all edges supported.

2.3 FASCIAS AND TRIM

2.3.1 Wood

Fascias and trim, including exterior door and window casing, shall be species and grade listed in TABLE I at the end of this section. Sizes shall be as indicated. Metal corners may be furnished in lieu of wood cornerboards for horizontal siding; and if furnished, shall be galvanized steel and primed or aluminum and primed.

2.4 WOOD SHINGLES

Wood shingles shall be No. 1 Grade, Red Cedar, Tidewater Red Cypress or California Redwood in accordance with applicable grading rules under which it is produced, random widths, 16, 18, 24 inches length, dip-stained at factory in color selected from manufacturer's standard colors. Wood shingles shall be fire-retardant treated as indicated.

2.5 COUNTER TOPS

2.5.1 Laminated Plastic

NEMA LD 3.

2.5.1.1 Countertop Finish

Grade GP 50 or PF 42, satin finish. Color and pattern shall be as indicated.

2.5.1.2 Backing Sheet

BK 20.

2.5.2 Solid Surface

Manufactured from homogeneous solid sheets for filled plastic resin complying with materials and performance requirements of ANSI Z 124.3, for Type 5 or Type 6, without a precoated finish.

2.6 MOISTURE CONTENT OF WOOD PRODUCTS

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products at time of delivery to the job site, and when installed, shall be as follows:

a. Interior Paneling: 12 percent.

b. Interior Finish Lumber, Trim, and Millwork 1 1/4 Inches Nominal or Less in Thickness: 12 percent on 85 percent of the pieces and 15 percent on remainder.

c. Exterior Treated and Untreated Finish Lumber and Trim 4 Inches Nominal or Less in Thickness: 19 percent.

d. Exterior Wood Siding: 15 percent.

e. Moisture content of other materials shall be in accordance with the applicable standards.

2.7 PRESERVATIVE TREATMENT OF WOOD PRODUCTS

2.7.1 Nonpressure Treatment

Treat woodwork and millwork, such as exterior trim, door trim, and window trim, in accordance with WDMA I.S. 4, with either 2 percent copper napthenate, 3 percent zinc napthenate, or 1.8 percent copper-8-quinolinolate. Provide a liberal brushcoat of preservative treatment to field cuts and holes.

2.7.2 Pressure Treatment

Lumber and plywood used on the exterior of buildings or in contact with masonry or concrete shall be treated with water-borne preservative listed in AWPA P5 in accordance with AWPA C1, AWPA C2, and AWPA C9, as applicable, and inspected in accordance with AWPA M2. Identify treatment on each piece of material by the quality mark of an agency accredited by the Board of

Review of the American Lumber Standards Committee. Plywood shall be treated to a reflection level as follows:

Exterior wood molding and millwork within 18 inches of soil, in contact with water or concrete shall be preservative-treated in accordance with WMMPA WM 6. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil.

2.8 FIRE-RETARDANT TREATMENT

2.8.1 Wood Products

Fire-retardant treated lumber shall be pressure treated in accordance with AWPA C20. Fire-retardant treated plywood shall be pressure treated in accordance with AWPA C27. Material use shall be defined in AWPA C20 and AWPA C27 for Interior Type A and B and Exterior Type. Treatment and performance inspection shall be by a qualified independent testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D 2898, Method A, prior to being tested for compliance with AWPA C20 or AWPA C27.

2.9 HARDWARE

Provide sizes, types, and spacings of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified.

2.9.1 Wood Screws

ASME B18.6.1.

2.9.2 Bolts, Nuts, Lag Screws, and Studs

ASME B18.2.1, ASME B18.2.2, and ASTM A 687.

2.9.3 Nails

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. For siding, length of nails shall be sufficient to extend 1-1/2 inches into supports, including wood sheathing over framing. Screws for use where nailing is impractical shall be size best suited for purpose.

2.9.4 Closet Hanger Rods

Chromium-plated steel rods, not less than one inch diameter by 18 gage. Rods may be adjustable with integral mounting brackets if smaller tube is one inch by 18 gage. Provide intermediate support bracket for rods more than 48 inches long.

2.10 FABRICATION

2.10.1 Quality Standards (QS)

The terms "Premium," "Custom," and "Economy" refer to the quality grades defined in AWI Qual Stds. Items not specified to be of a specific grade shall be Custom grade. The AWI QS is superseded by all contract document requirements indicated or stated herein.

2.10.2 Countertops

Fabricate with lumber and a core of exterior plywood or particleboard, glued and screwed to form an integral unit. Bond laminated plastic under pressure to exposed surfaces, using type of glue recommended by plastic manufacturer, and bond a backing sheet under pressure to underside of countertop. Countertop unit shall be post-formed type with no-drip nose, cove moulding, and Style A back splash, and covered with NEMA LD 3, Grade PF 42 plastic. Back splash shall be not less than 3 1/2 inches nor more than 4 1/2 inches high.

2.10.3 Cabinets

Wall and base cabinets and vanity cabinets shall be of the same construction and appearances. Fabricate with solid ends and frame fronts, or with frames all around. Frames shall be solid hardwood not less than 3/4 by 1 1/2 inches. Ends, bottom, back, partitions, and doors shall be hardwood plywood. Mortise and tenon, dovetail, or dowel and glue joints to produce a rigid unit. Cover exposed edges of plywood with hardwood strips. Doors, frames, and solid exposed ends shall be 3/4 inch thick; bottom, partitions, and framed ends 1/2 inch minimum; shelves 5/8 inch minimum; back 1/4 inch minimum.

2.10.3.1 Cabinet Hardware

BHMA A156.9. Provide hardware for each door, including two self-closing hinges. Provide two side-mounted metal drawer slides for each drawer. Hardware exposed to view shall be bright chromium plated, as indicated.

2.10.3.2 Finish

Provide a natural factory finish on wood surfaces after fabrication. Finish shall be fabricator's standard natural finish, except that it shall be equivalent to one coat of sealer and one coat of spar varnish on all surfaces and a second coat of spar varnish on surfaces exposed to view. Sand lightly and wipe clean between coats.

2.10.4 Workbenches

Fabricate as indicated. Dovetail and glue drawer corners. Fasten frames with suitable wood screws or bolts. Sand exposed surfaces smooth, and ease exposed edges. Provide two side-mounted, metal, ball-bearing drawer slides for each drawer, and at least two surface-mounted hinges and a magnetic catch, for each door.

2.10.5 Casework With Transparent Finish (CTF)

2.10.5.1 AWI Quality Grade (CTF)

Premium grade.

2.10.5.2 Semi-Exposed Parts

As specified in the AWI Qual Stds for the grade selected.

2.10.6 Casework With High Pressure Laminate Finish (CHPL)

2.10.6.1 AWI Quality Grade (CHPL)

Premium grade.

2.10.6.2 Semi-Exposed Surfaces

As specified in the AWI Qual Stds for the grade selected.

PART 3 EXECUTION

3.1 FINISH WORK

Provide sizes, materials, and designs as indicated and as specified. Apply primer to finish work before installing. Where practicable, shop assemble and finish items of built-up millwork. Joints shall be tight and constructed in a manner to conceal shrinkage. Miter trim and moldings at exterior angles and cope at interior angles and at returns. Material shall show no warp after installation. Install millwork and trim in maximum practical lengths. Fasten finish work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping. Provide blind return on all exposed edges.

3.1.1 Exterior Finish Work

Machine-sand exposed flat members and square edges. Machine-finish semi-exposed surfaces. Construct joints to exclude water. In addition to nailing, glue joints of built-up items with waterproof glue as necessary for weather-resistant construction. Provide well distributed end joints in built-up members. Provide shoulder joints in flat work. Hold backs of wide-faced miters together with metal rings and waterproof glue. Fascias and other flat members, unless otherwise indicated, shall be 3/4 inch thick. Provide door and window trim in single lengths. Provide braced, blocked, and rigidly anchored cornices for support and protection of vertical joints. Install soffits in largest practical size. Joints of plywood shall occur over center lines of supports. Fasten soffits with aluminum or stainless steel nails. Back prime all concealed surfaces of exterior trim.

3.1.2 Interior Finish Work

After installation, sand exposed surfaces smooth. Provide window and door trim in single lengths.

3.1.3 Door Frames

Set plumb and square. Provide solid blocking at not more than 16 inches o.c. for each jamb. Position blocking to occur behind hinges and lock strikes. Double wedge frames and fasten with finishing nails. Set nails for putty stopping.

3.1.4 Thresholds

Provide thresholds shaped as indicated 5/8 inch thick by 2 5/8 inches wide with beveled sides and cut to fit at jambs. Fasten thresholds with casing nails. Set nails for putty stopping.

3.1.5 Window Stools and Aprons

Provide stools with rabbet over window sill. Provide aprons with returns cut accurately to profile of member.

3.1.6 Bases

Flat member with a molded top and oak shoe mold. Fasten base to framing or to grounds. Nail shoe mold to the base. Set shoe mold, one-piece wood base after finish flooring is in place.

3.1.7 Finish Stair Work

Fit, nail, screw, bolt, and glue stair work together to form a strong rigid structure without squeaks or vibrations. Anchor newels and posts securely to rough stair framing. Cut newels, posts, and drops accurately around floor construction to make tight fit. Install balusters into treads and landings with glue. Install railing with straight runs following slope of stairs and with smooth curve turns. Return railing profile at ends and secure joints with bolts and nuts. Secure railing to posts and newels with concealed anchors. Support wall rails on metal brackets spaced near ends and not over 5 feet o.c.

3.2 SHELVING

one inch nominal thick wood shelf material or 3/4 or 23/32 inch thick plywood shelf material supported substantially with end and intermediate supports and arranged to prevent buckling and sagging. Hook strips shall be one by 4 inches nominal and cleats one by 2 inches nominal. Provide cleats except where hook strips are specified or indicated. Where adjustable shelving is indicated, provide standards and brackets or shelf rests for each shelf. Anchor standards to wall at not more than 2 feet o.c.

3.2.1 Linen Closets

Unless indicated otherwise, linen closets shall have a counter shelf 20 inches wide located 36 inches above the floor, a lower shelf approximately 18 inches wide and 18 inches above the floor, and three upper shelves 11 1/4 inches wide located 14 inches above the counter shelf and 14 inches apart.

3.2.2 Storage Rooms

Provide storage rooms with shelves of size and arrangement as indicated.

3.2.3 Room Closets

Provide two shelves 11 1/4 inches wide. Support lower shelf by hook strips at back and ends, and provide full-length wood or metal clothes hanger rods unless indicated otherwise.

3.2.4 Cleaning-Gear Closets

Provide shelves of size and arrangement indicated.

3.3 CLOTHES HANGER RODS

Provide clothes hanger rods where indicated and in closets having hook strips. Set rods parallel with front edges of shelves and support by sockets at each end and by intermediate brackets spaced not more than 4 feet o.c.

3.4 MISCELLANEOUS

3.4.1 Counters

Construct as indicated. Conceal fastenings where practicable, fit counter neatly, install in a rigid and substantial manner, and scribe to adjoining surfaces. Provide counter sections in longest lengths practicable; keep joints in tops to a minimum; and where joints are necessary, provide tight hairline joints drawn up with concealed-type heavy pull-up bolts. Glue joints with water-resistant glue and, in addition, make rigid and substantial with screws, bolts, or other approved fastenings.

3.4.2 Cabinets

Install level, plumb, and tight against adjacent walls. Secure cabinets to walls with concealed toggle bolts, and secure top to cabinet with concealed screws. Make cut-outs for fixtures to templates supplied by fixture manufacturer. Carefully locate cut-outs for pipes so that edges of holes will be covered by escutcheons.

3.4.3 Workbenches

Construct as indicated. Install level, plumb, and tight against adjacent construction. Fasten to walls with screws or toggle bolts and to floors with expansion bolts.

3.4.4 Wood Seats

Support seats on stanchions. Secure seats to supports with screws, bolts as required; countersink heads of bolts and fill holes with hardwood filler, finished flush with tops of seats.

3.4.5 Wood Bumpers

Bore, countersink, and bolt in place where indicated.

3.4.6 Catwalks in Attic Spaces

Lay boards with one inch spaces between. Stagger end joints, with each joint on a support.

3.5 SIDING

3.5.1 Installation of Siding

Fit and position without springing or otherwise forcing into place. For siding to have a stain finish, set nails and stop with nonstaining putty to match finished siding. For siding to have a paint finish, drive nails

flush.

3.5.2 Horizontal Siding

Make end joints over framing members and alternate so at least two boards will be between joints on same support. Uniformly distribute shorter pieces throughout area. Provide starter strips to establish proper slant for siding. Predrill ends of siding if necessary to prevent splitting when nailed. Horizontal bevel or plain lap siding: Overlap and nail into each support in accordance with recommendations of siding manufacturer. Horizontal drop siding: Work each course into top edge of previous course. Nail into each support with two nails, one near lower edge to clear top of previous course, and one just above mid-height of course, one nail just above mid-height of course.

3.5.3 Vertical Board Siding

Apply siding with horizontal joints only at locations indicated. Work each board into edge of previous course. Nail into supports at 24 inches on center with two nails, one blind if possible at or near joint with previous board, and one just outside board centerline.

3.5.4 Vertical Board and Batten Siding

Apply with horizontal joints only at locations indicated. Install each board with 1/2 inch space between it and previous board. Nail at center of board and into supports at 24 inches on center. Center battens over space between boards and nail down center at 16 inches on center.

3.5.5 Panel Siding

Apply panels with edges at joints spaced in accordance with manufacturer's recommendations. Shiplapped edges or square edges covered with battens shall be primed for paint finish, sealed for stain finish. Back all edges with framing members. Nail panels at edges 6 inches on center and at intermediate supports 12 inches on center. Edge nailing to be 3/8 inch from edges. For shiplap joints, nail 3/8 inch from visible joint and at a location to penetrate lap with previous panel. When panel siding is part of an engineered shear wall or used as wall-bracing, nail shiplap joints to supports with double rows of nails. Space battens at 12 inches on center and nail down center at 24 inches on center.

3.6 SOFFITS

3.6.1 Wood

Panels shall be applied with edges at joints spaced in accordance with manufacturer's instructions and with all edges backed with framing members. Panels shall be nailed 3/8 inch from edges at 6 inches on center and at intermediate supports at12 inches on center. Panels shall be installed using the maximum practical lengths.

3.7 FASCIAS AND EXTERIOR TRIM

Exposed surfaces and square edges shall be machine sanded, caulked, and constructed to exclude water. Joints of built-up items, in addition to nailing, shall be glued as necessary for weather-resistant construction. End joints in built-up members shall be well distributed. Joints in flat work shall be shouldered. Backs of wide-faced miters shall be held

together with metal rings and glue. Fascias and other flat members shall be in maximum practicable lengths. Cornices shall be braced, blocked, and rigidly anchored for support and protection of vertical joints.

3.8 MOLDING AND INTERIOR TRIM

Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

3.9 WOOD SHINGLES

Wood shingles shall be applied by single-coursing method and with a weather exposure of 7-1/2, 8-1/2, 11-1/2 inches. Each shingle shall be nailed with two nails 1 inch above butt line of the next course, except shingles more than 8 inches in width shall be nailed with three nails. Starter course shall be doubled, and vertical joints shall be offset from vertical joints of the previous course. Corners shall be mitered over flashing, abutted to a cedar or redwood strip at the corner, as indicated.

-- End of Section --

SECTION 06 41 16.00 10

LAMINATE CLAD ARCHITECTURAL CASEWORK

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2	(1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(8th Edition) AWI Quality Standards

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 547	(2006) Nails for Use with Wood and Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(2003) Cabinet Hardware

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.2	Medium Density Fiberboard (MDF) for Interior Applications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1997) Architectural Wood Flush Doors

1.2 GENERAL DESCRIPTION

Work in this section includes laminate clad custom casework cabinets, vanities as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. The Contractor shall comply with EPA requirements in accordance

with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09 90 00 PAINTS AND COATINGS.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings
Installation

Shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

SD-03 Product Data

Wood Materials
Wood Finishes
Finish Schedule

Descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI Qual Stds for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Plastic Laminates

Two samples of each plastic laminate pattern and color. Samples shall be a minimum of 5 by 7 inches in size.

Cabinet Hardware

One sample of each cabinet hardware item specified to include hinges, pulls, drawer glides.

SD-07 Certificates

Quality Assurance
Laminate Clad Casework

A quality control statement which illustrates compliance with and understanding of AWI Qual Stds requirements, in general, and the specific AWI Qual Stds requirements provided in this specification. The quality control statement shall also certify a minimum of ten years Contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

1.4 QUALITY ASSURANCE

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the premium, custom grade quality standards as outlined in AWI Qual Stds, Section 400G and Section 400B for laminate clad cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Contractor must demonstrate knowledge and understanding of AWI Qual Stds requirements for the quality grade indicated.

1.5 MOCK-UP

Prior to final approval of shop drawings, a full-size mock-up shall be provided of a typical vanity, floor cabinet, wall cabinet. The mock-up shall include all components and hardware necessary to illustrate a completed unit and shall include a minimum of one door and one drawer assembly. The completed mock-up shall include countertops and back splashes where specified. The mock-up shall utilize specified finishes in the patterns and colors as indicated on the drawings or as indicated in Section 09 06 90 COLOR SCHEDULE. Upon disapproval, the Contractor shall rework or remake the mock-up until approval is secured. Rejected units shall be removed from the jobsite. Approved mock-up may remain as part of the finished work.

1.6 DELIVERY AND STORAGE

Casework may be delivered knockdown or fully assembled. All units shall be delivered to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.7 SEQUENCING AND SCHEDULING

Work shall be coordinated with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

1.8 PROJECT/SITE CONDITIONS

Field measurements shall be verified as indicated in the shop drawings before fabrication.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

a. All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood.

b. Standing or running trim casework components which are specified to receive a transparent finish shall be birch hardwood species, plain sawn. AWI grade shall be premium, custom. Location, shape, and dimensions shall be as indicated on the drawings.

2.1.2 Panel Products

2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, AWI Qual Stds Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

2.1.2.2 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in CPA A208.2.

2.2 SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06 61 16 SOLID POLYMER (SOLID SURFACING) FABRICATIONS.

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings Section 09 06 90 COLOR SCHEDULE. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 0.042 inches (plus or minus 0.005 inches) in thithickness. This laminate grade is intended for horizontal surfaces where post forming is required.

2.3.4 Vertical General Purpose Postformable (VGP) Grade

Vertical general purpose postformable grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of components where postforming is required for curved surfaces.

2.3.5 Horizontal General Purpose Fire Rated (HGF) Grade

Horizontal general purpose fire rated grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. Laminate grade shall have a class 1, class A fire rating in accordance with ASTM E 84.

2.3.6 Vertical General Purpose Fire Rated (VGF) Grade

Vertical general purpose fire rated grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade shall have a class 1, class A fire rating in accordance with ASTM E 84.

2.3.7 Cabinet Liner Standard (CLS) Grade

Cabinet liner standard grade plastic laminate shall be 0.020 inches in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

2.3.8 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.020 inches. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.125 inch thick. Material width shall be 15/16 inches as indicated on the drawings. Color and pattern shall match exposed door and drawer front laminate pattern and color be as indicated on the drawings.

2.5 VINYL COUNTERTOP EDGE

Where located on the drawings, vinyl edging for countertops shall be a tee-mould anchor type with a flat edge profile. Finished width shall be as indicated on the drawings. Color shall be as indicated on the drawings.

2.6 CABINET HARDWARE

All hardware shall conform to BHMA A156.9, unless otherwise noted, and shall consist of the following components:

a. Door Hinges:

b. Cabinet Pulls:

c. Drawer Slide: Side mounted with full extension and a minimum 100 pound load capacity. Slides shall include an positive stop to avoid accidental drawer removal.

d. Adjustable Shelf Support System:

1) Recessed (mortised) metal standards. Support clips for the standards shall be open type, BHMA No. B04091 or

2) Multiple holes with metal pin supports.

2.7 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

2.8 ADHESIVES, CAULKS, AND SEALANTS

2.8.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

2.8.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use. Adhesives shall withstand a bond test as described in WDMA I.S. 1-A.

2.8.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be adhesive consistant with AWI and laminate manufacturer's recommendations. PVC edgebanding shall be adhered using a polymer-based hot melt glue.

2.8.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.8.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

2.9 WOOD FINISHES

Paint, stain, varnish and their applications required for laminate clad casework components shall be as indicated in Section 09 90 00 PAINTS AND COATINGS. Color and location shall be as indicated on the drawings.

2.10 ACCCESSORIES

2.10.1 Glass and Glazing

Glass required in laminated casework shall be referenced by type in accordance with Section 08 81 00 GLAZING. Glass shall be one of the following:

2.11 FABRICATION

Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI premium, custom grade unless otherwise indicated in this specification. Cabinet style, in accordance with AWI Qual Stds, Section 400-G descriptions, shall be flush overlay flush inset without face frame as indicated on the drawings.

2.11.1 Base and Wall Cabinet Case Body

2.11.1.1 Cabinet Components

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

a. Body Members (Ends, Divisions, Bottoms, and Tops): 3/4 inch medium density fiberboard 9MDF) veneer core plywood panel product.

b. Face Frames and Rails: 3/4 inch hardwood lumber.

c. Shelving: 3/4 inch medium density fiberboard 9MDF veneer core plywood panel product.

d. Cabinet Backs: 1/4 inch veneer core plywood panel product.

e. Drawer Sides, Backs, and Subfronts: 1/2 inch panel product.

f. Drawer Bottoms: 1/4 inch veneer core plywood panel product.

g. Door and Drawer Fronts: 3/4-inch panel product.

2.11.1.2 Joinery Method for Case Body Members

a. Tops, Exposed Ends, and Bottoms.

1) Steel "European" assembly screws (1-1/2 inch from end, 5 inch on center, fasteners will not be visible on exposed parts).

2) Doweled, glued under pressure (approx. 4 dowels per 12 inches of joint).

3) Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

4) Spline or biscuit, glued under pressure.

b. Exposed End Corner and Face Frame Attachment.

1) For mitered joint: lock miter or spline or biscuit, glued under pressure (no visible fasteners).

2) For non-mitered joint (90 degree): butt joint glued under pressure (no visible fasteners).

3) Butt joint, glued and nailed.

c. Cabinet Backs (Wall Hung Cabinets): Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

1) Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.

2) Full overlay, plant-on backs with minimum back thickness of 1/2 inchand minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

3) Side bound, captured in groove or rabbetts; glued and fastened.

d. Cabinet Backs (Floor Standing Cabinets).

1) Side bound, captured in grooves; glued and fastened to top and bottom.

2) Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

3) Side bound, placed in rabbetts; glued and fastened in rabbetts.

e. Wall Anchor Strips shall be required for all cabinets with backs less than 1/2 inch thick. Strips shall consist of minimum 1/2 inch thick lumber, minimum 2-1/2 inches width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.11.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of nominal 2 inch thick lumber. Base assembly components shall be treated lumber. Finished height for each cabinet base shall be not less than the full height of the installed, specified wall base or as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall be flush with top of base.

2.11.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 3/4 inch medium density fiberboard (MDF. All door and drawer front edges shall be surfaced with high pressure plastic laminate PVC edgebanding, color and pattern to match exterior face laminate or as indicated on the drawings.

2.11.4 Drawer Assembly

2.11.4.1 Drawer Components

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

a. Drawer Sides and Backs For Transparent Finish: 1/2 inch thick solid hardwood lumber, 7-ply hardwood veneer core plywood (no voids), any species.

b. Drawer Sides and Backs For Laminate Finish: 1/2 inch thick 7-ply hardwood veneer core substrate.

c. Drawer Sides and Back For Thermoset Decorative Overlay (melamine) Finish: 1/2 inch thick medium density particleboard or MDF fiberboard substrate.

d. Drawer Bottom: 1/4 inch thick veneer core panel product for transparent or plastic laminate finish, thermoset decorative overlay melamine panel product.

2.11.4.2 Drawer Assembly Joinery Method

a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.

b. Doweled, glued under pressure.

c. Lock shoulder, glued and pin nailed.

d. Bottoms shall be set into sides, front, and back, 1/4 inch deep groove with a minimum 3/8 inch standing shoulder.

2.11.5 Shelving

2.11.5.1 General Requirements

Shelving shall be fabricated from 3/4 inch medium density fiberboard (MDF 3/4 inch veneer core plywood. All shelving top and bottom surfaces shall be finished with HPDL plastic laminate. Shelf edges shall be finished in a HPDL plastic laminate PVC edgebanding.

2.11.5.2 Shelf Support System

The shelf support system shall be:

a. Recessed (mortised) metal shelf standards. Standards shall be mortised flush with the finishes surface of the cabinet interior side walls, two per side. Standards shall be positioned and spaced on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Standards shall be installed and adjusted vertically to provide a level, stable shelf surface when clips are in place.

b. Pin Hole Method. Holes shall be drilled on the interior surface of the cabinet side walls. Holes shall be evenly spaced in two vertical

columns The holes in each column shall be spaced at 1 inch increments starting 6 inches from the cabinet interior bottom and extending to within 6 inches of the top interior surface of the cabinet. Holes shall be drilled to provide a level, stable surface when the shelf is resting on the shelf pins. Hole diameter shall be coordinated with pin insert size to provide a firm, tight fit.

2.11.6 Laminate Clad Countertops

Laminate countertop substrate shall be constructed of 3/4 inch veneer core plywood. The substrate shall be moisture-resistant where countertops receive sinks, lavatories, or are subjected to liquids. All substrates shall have sink cutout edges sealed with appropriate sealant against moisture. No joints shall occur at any cutouts. A balanced backer sheet is required.

2.11.6.1 Edge Style

Front and exposed side countertop edges shall be in shapes and to dimensions as shown on the drawings. The countertop edge material shall be:

a. Post formed plastic laminate. Laminate edge shall be integral with countertop surface. Shape and profile shall be bullnose as indicated on the drawings and to dimensions as indicated on the drawings.

b. Hardwood. Species, finish, profile, shape, and dimensions shall be as indicated on the drawings. Hardwood edge shall overlap the exposed countertop laminate edge and shall be installed flush with the countertop laminate surface.

c. Vinyl. Vinyl tee-mould edge shall be in shape, thickness, and color as indicated on the drawings. Tee mould edge shall overlap the exposed countertop laminate edge and shall be installed flush with the countertop laminate surface.

d. Plastic laminate Self Edge. Flat, 90 degree "self " edge. Edge must be applied before top. Laminate edge shall overlap countertop laminate and shall be eased to eliminate sharp corners.

2.11.6.2 Laminate Clad Splashes

Countertop splash substrate shall be 3/4 inch veneer core plywood. Laminate clad backsplash shall be integral with countertop, coved to radius and to dimensions as indicated on the drawings. Side splashes shall be straight profile and provided loose, to be installed at the time of countertop installation. Back and side splash laminate pattern and color shall match the adjacent countertop laminate.

2.11.7 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and NEMA LD 3, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush,

filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

a. Base/Wall Cabinet Case Body.

1) Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS VGP.

2) Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: HPDL Grade CLS Thermoset Decorative Overlay (melamine).

b. Adjustable Shelving.

1) Top and bottom surfaces: HPDL Grade HGS Overlay (melamine).

2) All edges: HPDL Grade VGS, Thermoset Decorative Overlay PVC edgebanding.

c. Fixed Shelving.

1) Top and bottom surfaces: HPDL Grade HGS Overlay (melamine).

2) Exposed edges: HPDL Grade VGS, Thermoset Decorative Overlay PVC edgebanding.

d. Door, Drawer Fronts, Access Panels.

1) Exterior (exposed) and interior (semi-exposed) faces: HPDL Grade VGS VGP

2) Edges: HPDL Grade VGS PVC edgebanding.

e. Drawer Assembly.

All interior and exterior surfaces: HPDL Grade CLS, Thermoset Decorative Overlay (melamine).

f. Countertops and Splashes.

All exposed and semi-exposed surfaces: HPDL Grade HGS

g. Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Qual Stds premium, custom grade requirements.

2.11.8 Finishing

2.11.8.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

2.11.8.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

2.11.8.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule, drawings and Section 09 90 00 PAINTS AND COATINGS. All cabinet reveals shall be painted.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Qual Stds premium, custom quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinetsshall utilize a floor anchoring system as detailed on the drawings. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners as indicated in the drawings. Where assembly abutts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Cabinet vanity to be wall mounted shall utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2 Countertops

Countertops shall be installed in locations as indicated on the drawings. Countertops shall be fastened to supporting casework structure with mechanical fasteners, hidden from view. All joints formed by the countertop or countertop splash and adjacent wall surfaces shall be filled with a clear silicone caulk. Loose back, side splashes shall be adhered to both the countertop surface perimeter and the adjacent wall surface with adhesives appropriate for the type of materials to be adhered. Joints between the countertop surface and splash shall be filled with clear silicone caulk in a smooth consistent concave bead. Bead size shall be the minimum necessary to fill the joint and any surrounding voids or cracks.

3.1.3 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or

synthetic insertion dowels shall be used to receive 3/16 inch "Euroscrews". The use of wood screws without insertion dowels is prohibited.

3.1.4 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI Qual Stds premium grade requirements.

3.1.5 Plumbing Fixtures

Sinks, sink hardware, and other plumbing fixtures shall be installed in locations as indicated on the drawings and in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.1.6 Glass

Glass and glazing shall be installed in the casework using methods and materials specified in Section 08 81 00 GLAZING in locations as indicated on the drawings.

-- End of Section --

SECTION 06 61 16

SOLID POLYMER (SOLID SURFACING) FABRICATIONS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2583	(2007) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D 570	(1998; R 2005) Standard Test Method for Water Absorption of Plastics
ASTM D 638	(2003) Standard Test Method for Tensile Properties of Plastics
ASTM D 696	(2003) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G 21	(1996; R 2002) Determining Resistance of Synthetic Polymeric Materials to Fungi

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO Z124.3	(1995) Plastic Lavatories
IAPMO Z124.6	(1997) Plastic Sinks

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

NSF INTERNATIONAL (NSF)

NSF 51	(2007) Food Equipment Materials

TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk	(2007) Handbook for Ceramic Tile

Installation

1.2 GENERAL DESCRIPTION

Work in this section includes _____ and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected. Variation in component size and location of openings to be plus or minus 1/8 inch.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings
Installation

Detail Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work.

SD-03 Product Data

Solid polymer material
Qualifications
Fabrications

Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, sealants, and heat reflective tape. Both the manufacturer of materials and the fabricator shall submit a detailed description of operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Material

A minimum 4 by 4 inch sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work.

Counter and Vanity Tops

A minimum 1 foot wide by 6 inch deep, full size sample for each type of counter top shown on the project drawings. The sample shall include the edge profile and backsplash as detailed on the project drawings. Solid polymer material shall be of a pattern and color as indicated on the drawings. Sample shall include at

least one seam. Approved sample shall be retained as standard for this work.

SD-06 Test Reports

Solid polymer material

Test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.

SD-07 Certificates

Fabrications
Qualifications

Solid polymer manufacturer's certification attesting to fabricator qualification approval.

SD-10 Operation and Maintenance Data

Clean-up

A minimum of six copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided,if available. Maintenance kit for matte finishes shall be submitted.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Components and materials shall be delivered to the site undamaged, in containers clearly marked and labeled with manufacturer's name. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

1.5 WARRANTY

Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

1.6 QUALIFICATIONS

To insure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials.

1.7 MOCK-UP

The Contractor shall submit Detail Drawings as specified in the Submittals paragraph, under SD-02. Prior to final approval of shop drawings, a full-size mock-up shall be provided of a typical vanity top, countertop

shelving where multiple units are required. The mock-up shall include all solid polymer components required to provide a completed unit. The mock-up shall utilize finishes in patterns and colors indicated on the drawings. Should the mock-up not be approved, the Contractor shall re-work or remake it until approval is secured. Rejected units shall be removed from the jobsite. Approved mock-up may remain as part of the finished work.

PART 2 PRODUCTS

2.1 MATERIAL

Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting IAPMO Z124.3 and IAPMO Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than 1/4 inch in thickness.

2.1.1 Cast,100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	5800 psi (min.)	ASTM D 638
Hardness	55-Barcol Impressor (min.)	ASTM D 2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D 696
Boiling water Surface Resistance	No Change	NEMA LD 3-3.05
High Temperature Resistance	No Change	NEMA LD 3-3.06
Impact Resistance (Ball drop)		NEMA LD 3-303
1/4" sheet	36", 1/2 lb ball, no failure	
1/2" sheet	140", 1/2 lb ball, no failure	
3/4" sheet	200", 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G 21
Bacteria Growth	No Growth	ASTM G 21
Liquid		

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Absorption (Weight in 24 hrs.)	0.1% max.	ASTM D 570
Flammability		ASTM E 84
Flame Spread	25 max.	
Smoke Developed	30 max	
Sanitation	"Food Contact" approval	NSF 51

2.1.2 Acrylic-modified Polymer Solid Surfacing Material

Cast, solid polymer material shall be composed of a formulation containing acrylic and polyester polymers, mineral fillers, and pigments. Acrylic polymer content shall be not less than 5 percent and not more than 10 percent in order to meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4100 psi (min.)	ASTM D 638
Hardness	50-Barcol Impressor (min.)	ASTM D 2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D 696
Boiling water Surface Resistance	No Change	NEMA LD 3-3.05
High Temperature Resistance	No Change	NEMA LD 3-3.06
Impact Resistance (Ball drop)		NEMA LD 3-303
1/4" sheet	36", 1/2 lb ball, no failure	
1/2" sheet	140", 1/2 lb ball, no failure	
3/4" sheet	200", 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G 21
Bacteria Growth	No Growth	ASTM G 21
Liquid Absorption (Weight in 24 hrs.)	0.6% max.	ASTM D 570
Flammability		ASTM E 84

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Flame Spread	25 max.	
Smoke Developed	100 max	
Sanitation	"Food Contact" approval	NSF 51

2.1.3 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project drawings, color schedule. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

2.1.4 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be matte; gloss rating of 5-20, semigloss; gloss rating of 25-50, polished; gloss rating of 55-80, as indicated on the drawings.

2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting TCA Hdbk, Underwriter's Laboratories (UL) listed. This adhesive shall be used to bond solid polymer components to adjacent and underlying substrates.

2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and OSHA Nationally Recognized Testing Laboratory (NRTL) listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Sealant shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

2.2.4 Conductive Tape

Conductive tape shall be manufacturer's standard foil tape, 4 mils thick, applied around the edges of cut outs containing hot or cold appliances.

2.2.5 Insulating Felt Tape

Insulating tape shall be manufacturer's standard product for use with drop-in food wells used in commercial food service applications to insulate solid polymer surfaces from hot or cold appliances.

2.2.6 Heat Reflective Tape

Heat reflective tape as recommended by the solid polymer manufacturer for use with cutouts for heat sources.

2.2.7 Mounting Hardware

Provide mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

2.3 FABRICATIONS

Components shall be factory or shop fabricated to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Factory cutouts shall be provided for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected.

2.3.1 Joints and Seams

Joints and seams shall be formed between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter and Vanity Top Splashes

Backsplashes and end splashes shall be fabricated from 1/2 inch thick solid surfacing material and shall be 4 inches high provided to dimensions and shapes as indicated on the drawings. Backsplashes and end splashes shall be provided for all counter tops and vanity tops at locations indicated on the drawings. Backsplashes shall be shop fabricated and be permanently attached.

2.3.3.1 Permanently Attached Backsplash

Permanently attached backsplashes shall be attached straight with seam adhesive to form a 90 degree transition, attached with seam adhesive and to form a radiused coved transition from countertop to backsplash.

2.3.3.2 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Shelving

Shelving and wall support brackets shall be fabricated from 1/2 inch thick solid surfacing, solid polymer material. Dimensions, edge shape, and other details shall be as indicated on the drawings.

2.3.5 Window Stools

Window stools shall be fabricated from 1/2 inch thick solid surfacing, solid polymer material. Dimensions, edge shape, and other details shall be as indicated on the drawings, selected from manufacturer's available pre-fabricated standards.

2.3.6 Counter and Vanity Tops

All solid surfacing, solid polymer counter top and vanity top components shall be fabricated from 1/2 inch thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Counter tops shall be complete with 4 inch high permanently attached, 90 degree transition, permanently attached with coved transition backsplash and loose endsplashes at all locations where indicated on the drawings. Attach 2 inch wide reinforcing strip of polymer material under each horizontal counter top seam.

2.3.6.1 Counter Top With Sink

A. Stainless Steel or Vitreous China Sink.

Countertops with sinks shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for stainless steel, vitreous china, rimless installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 22 00 00 PLUMBING,GENERAL PURPOSE.

B. Solid Polymer Sink

Solid polymer sinks shall be a manufacturer's standard, pre-molded product specifically designed for attachment to solid polymer counter tops.

2.3.6.2 Vanity Tops With Bowls

A. Vitreous China Bowl

Countertops with vitreous china bowls shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for vitreous china rimless installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 22 00 00 PLUMBING,GENERAL PURPOSE.

B. Solid Polymer Bowl

Solid polymer bowls shall be a solid polymer manufacturer's standard, pre-molded product specifically designed for attachment to solid polymer counter tops.

C. One-Piece Vanity Top and Bowl

One-piece vanity top and bowl fabrications shall be a standard pre-fabricated product provided by the solid polymer manufacturer. Each unit shall include a vanity top with integral backsplash and sink bowl.

2.3.6.3 Cafeteria Counter Tops

Cutouts for cold or hot appliances shall be made to templates furnished by the equipment manufacturers. Joints and cutouts shall be reinforced as recommended by the solid polymer manufacturer. Insulation shall be provided between the solid polymer surface and all appliances, hot or cold. Hot applications shall be thermally isolated from cold applications in accordance with the solid polymer manufacturer's recommendations. Provide expansion joints as necessary to accommodate hot appliances. Where cabinets exist beneath counter tops, adequate ventilation shall be provided to prevent heat build-up.

2.3.7 Solid Polymer Sinks

Solid polymer sinks shall be a standard product of the solid polymer manufacturer, designed specifically to be installed in solid polymer countertops. Sinks shall be of the same polymer composition as the adjoining counter top. Sink design shall support a seam adhesive undermount installation method. Sinks shall be a single bowl, double bowl or double bowl with molded drainboard configuration. Sink dimensions shall be as indicated on the drawings.

2.3.8 Solid Polymer Vanity Bowls

Solid polymer vanity bowls shall be a standard product of the solid polymer manufacturer, designed specifically to be installed in solid polymer vanity tops. Bowls shall be of the same polymer composition as the adjoining counter top. Bowl design shall support a seam adhesive undermount installation method. Bowl dimensions shall be as indicated on the drawings.

2.3.9 Tub/Shower Wall Panel System

Tub/shower wall enclosures shall provide a system of solid polymer components to include: panels, corner trim, soap dish, shampoo shelf, panel edge trim. Dimensions of all components shall be as indicated on the drawings, standard manufacturer's dimensions to be field cut to fit. Panels shall be formed from manufacturer's standard 1/4 inch thick sheet product. Panels shall be full width and height with seams occurring only at the inside corners of the enclosure. Soap dish and shampoo shelf shall be of a configuration, shape, and location as indicated on the drawings.

2.3.10 Wall Cladding/Wainscotting

Solid polymer wall cladding or wainscotting shall be provided to dimensions and in locations as shown on the drawings. Panels shall be fabricated from manufacturer's standard 1/4 inch thick sheet product. Panels shall be provided to heights shown on the drawings with no horizontal seaming. Panels shall utilize the maximum panel dimension available to minimize vertical seams.

2.3.11 Toilet/Shower Partition System

Floor-mounted, solid polymer toilet, shower partition system shall be

provided to dimensions and as standard manufacturer's dimensions in locations as shown on the drawings. Panels and pilasters shall be fabricated from manufacturer's standard 1/2 inch thick sheet product. System shall include all necessary hardware for installation and mounting of panels, pilasters, and doors.

PART 3 EXECUTION

3.1 COORDINATION

In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to insure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of wall panels, countertops, shelving, and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer. Contractor shall appropriate staging areas for solid polymer fabrications.

3.2 INSTALLATION

3.2.1 Components

All components and fabricated units shall be installed plumb, level, and rigid. Field joints between solid polymer components to provide a monolithic appearance shall be made using solid polymer manufacturer's approved seam adhesives, with joints inconspicuous in the finished work. Metal or vitreous china sinks and lavatory bowls shall be attached to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Solid polymer sinks and bowls shall be installed using a color-matched seam adhesive. Plumbing connections to sinks and lavatories shall be made in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.1.1 Wall Panels & Panel Systems

Installation of wall panels and system components to substrates shall include the use of a neoprene-based panel adhesive. Seam adhesive shall be used to adhere all solid polymer components to each other with the exception of expansion joints and inside corners. All inside corners and expansion joints between solid polymer components shall be joined with silicone sealant. All joints between solid polymer components and non-solid polymer surfaces shall be sealed with a clear silicone sealant.

3.2.2 Silicone Sealant

A clear, silicone sealant or caulk shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

3.2.3 Plumbing

Plumbing connections to sinks and lavatories shall be made in accordance

with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.3 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made. The Contractor shall submit maintenance data as specified in the Submittals paragraph, under SD-10.

-- End of Section --

SECTION 07 14 00

FLUID-APPLIED WATERPROOFING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 836	(2006) High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1751	(2004) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fluid-applied membrane

Membrane primer

Elastomeric sheet

Flexible foam-backed elastomeric sheet

Solvent

Moisture meter

Protection board

Bond breaker

Submit material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

1.3 PREWATERPROOFING CONFERENCE

Prior to starting application of waterproofing system, arrange and attend a prewaterproofing conference to ensure a clear understanding of drawings and specifications. Give the Contracting Officer 7 days advance written notice of the time and place of meeting. Ensure that the mechanical and electrical subcontractor, flashing and sheetmetal subcontractor, and other trades that may perform other types of work on or over the membrane after installation, attend this conference.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by a referenced specification number shall bear the specification number, type, and class of the contents. Deliver materials in sufficient quantity to continue work without interruption. Store and protect materials in accordance with manufacturer's instructions, and use within their indicated shelf life. When hazardous materials are involved, adhere to special precautions of the manufacturer, unless precautions conflict with local, state, and federal regulations. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture or freezing. Store materials on pallets and cover from top to bottom with canvas tarpaulins.

1.5 ENVIRONMENTAL CONDITIONS

Apply materials when ambient temperature is 40 degrees F or above for a period of 24 hours prior to the application and when there is no ice, frost, surface moisture, or visible dampness on the substrate surface. Apply materials when air temperature is expected to remain above 40 degrees F during the cure period recommended by the manufacturer. Moisture test for substrate is specified under paragraph entitled "Moisture Test." Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum of 40 degrees F for 24 hours prior to the application of the waterproofing, and remains above that temperature during the cure period recommended by the manufacturer.

PART 2 PRODUCTS

2.1 FLUID-APPLIED MEMBRANE

ASTM C 836.

2.2 MEMBRANE PRIMER

As recommended by the fluid-applied membrane manufacturer unless specifically prohibited by the manufacturer of the fluid-applied membrane.

2.3 SEALANT

As specified in Section 07 92 00 JOINT SEALANTS.

2.4 SEALANT PRIMER

As specified in Section 07 92 00 JOINT SEALANTS.

2.5 BACKING MATERIAL

Premolded, closed-cell, polyethylene, or polyurethane foam rod having a diameter 25 percent larger than joint width before being compressed into joint. Provide bond breaker of polyethylene film or other suitable material between backing material and sealant.

2.6 JOINT FILLER

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, ASTM D 1751 or ASTM D 1752.

2.7 BOND BREAKER

As recommended by the fluid-applied membrane manufacturer. Bond breaker shall not interfere with the curing process or other performance properties of the fluid-applied membrane.

2.8 ELASTOMERIC SHEET

Preformed; as recommended by the fluid-applied membrane manufacturer. Bond strength between the fluid-applied membrane and the preformed elastomeric sheet shall be a minimum of one psi when tested in accordance with ASTM C 836.

2.9 ELASTOMERIC SHEET ADHESIVE

As recommended by the elastomeric sheet manufacturer.

2.10 FLEXIBLE FOAM-BACKED ELASTOMERIC SHEET

Flexible foam-backed elastomeric sheet for protection over preformed elastomeric sheet at expansion joints shall be 1/2 inch thick, minimum, closed cell foam conforming to ASTM D 1056, Type 2, Class B, Grades 2 or 3, factory-bonded to 1/16 inch thick, minimum, preformed elastomeric sheet.

2.11 PROTECTION BOARD

Premolded bitumen composition board, 1/8 inch minimum thickness or other composition board compatible with the fluid-applied membrane.

2.12 DRAINAGE COURSE AGGREGATE

ASTM C 33, size No. 8.

2.13 INSULATION

Polystyrene foam conforming to ASTM C 578, Class IV, thickness as indicated, required by indicated R-value.

PART 3 EXECUTION

3.1 PREPARATION

Coordinate work with that of other trades to ensure that components to be incorporated into the waterproofing system are available when needed. Inspect and approve surfaces immediately before application of waterproofing materials. Remove laitance, loose aggregate, sharp projections, grease, oil, dirt, curing compounds, and other contaminants which could adversely affect the complete bonding of the fluid-applied membrane to the concrete surface.

3.1.1 Flashings

Make penetrations through sleeves in concrete slab watertight before application of waterproofing. After flashing is completed, cover elastomeric sheet with fluid-applied waterproofing during waterproofing application.

3.1.1.1 Drains

Make drain flanges flush with surface of structural slab. Apply a full elastomeric sheet around the drain, with edges fully adhered to drain flange and to structural slab. Do not adhere elastomeric sheet over joint between drain and concrete slab. Do not plug drainage or weep holes. Cover elastomeric sheet with fluid-applied waterproofing during waterproofing application. Lap elastomeric sheet a minimum of 4 inches onto concrete slab.

3.1.1.2 Penetrations and Projections

Flash penetrations and projections through structural slab with an elastomeric sheet adhered to the concrete slab and the penetration. Leave elastomeric sheet unadhered for one inch over joint between penetration and concrete slab. Adhere elastomeric sheet a minimum of 4 inches onto horizontal deck.

3.1.1.3 Walls and Vertical Surfaces

Flash wall intersections which are not of monolithic pour or constructed with reinforced concrete joints with an elastomeric sheet adhered to both vertical wall surfaces and concrete slab. Flash intersections which are monolithically poured or constructed with reinforced concrete joints with either an elastomeric sheet or a vertical grade of fluid-applied waterproofing adhered to vertical wall surfaces and concrete slab. Leave sheet unadhered for a distance of one inch from the corner on both vertical and horizontal surfaces.

3.1.2 Cracks and Joints

Prepare visible cracks and joints in substrate to receive fluid-applied waterproofing membrane by placing a bond breaker and an elastomeric slip sheet between membrane and substrate. Cracks that show movement shall receive a 2 inch bond breaker followed by an elastomeric sheet adhered to the deck. Nonmoving cracks shall be double coated with fluid-applied waterproofing.

3.1.3 Priming

Prime surfaces to receive fluid-applied waterproofing membrane. Apply primer as required by membrane manufacturer's printed instructions.

3.2 SPECIAL PRECAUTIONS

Protect waterproofing materials during transport and application. Do not dilute primers and other materials, unless specifically recommended by materials manufacturer. Keep containers closed except when removing contents. Do not mix remains of unlike materials. Thoroughly remove residual materials before using application equipment for mixing and transporting materials. Do not permit equipment on the project site that has residue of materials used on previous projects. Use cleaners only for cleaning, not for thinning primers or membrane materials. Ensure that workers and others who walk on cured membrane wear clean, soft-soled shoes to avoid damaging the waterproofing materials.

3.3 APPLICATION

Over primed surfaces, provide a uniform, wet, monolithic coating of fluid-applied membrane, 60 mils thick, plus or minus 5 mils by following manufacturer's printed instructions. Apply material by trowel, squeegee, roller, brush, spray apparatus, or other method recommended by membrane manufacturer. Check wet film thickness as specified in paragraph entitled "Film Thickness" and adjust application rate as necessary to provide a uniform coating of the thickness specified. Where possible, mark off surface to be coated in equal units to facilitate proper coverage. At expansion joints, control joints, prepared cracks, flashing, and terminations, carry membrane over preformed elastomeric sheet in a uniform 60 mil thick, plus or minus 5 mils, wet thickness to provide a monolithic coating. If membrane cures before next application, wipe previously applied membrane with a solvent to remove dirt and dust that could inhibit adhesion of overlapping membrane coat. Use solvent recommended by the membrane manufacturer, as approved.

3.3.1 Work Sequence

Perform work so that protection board is installed prior to using the waterproofed surface. Do not permanently install protection board until the membrane has passed the flood test specified under paragraph entitled "Flood Test." Move material storage areas as work progresses to prevent abuse of membrane and overloading of structural deck.

3.3.2 Protection Board

Protect fluid-applied membrane by placing protection board over membrane at a time recommended by the membrane manufacturer. Protect membrane application when protection board is not placed immediately. Butt protection boards together and do not overlap.

3.3.3 Drainage Course

Place drainage course where shown after flood tests are completed and concrete protection slab or wearing course is ready to be installed.

3.3.4 Insulation

Place insulation of thickness indicated, on top of drainage course just

prior to placement of concrete protection slab.

3.4 FIELD QUALITY CONTROL

3.4.1 Moisture Test

Prior to application of fluid-applied waterproofing, measure moisture content of substrate with a moisture meter in the presence of the Contracting Officer. An acceptable device is the Delmhorst Moisture Meter, Model BD7/2E/CS, Type 21 E. Similar meters by other manufacturers, which are suitable for the purpose, may be used as approved by the Contracting Officer. Do not begin application until meter reading indicates "dry" range.

3.4.2 Film Thickness

Measure wet film thickness every 100 square feetduring application by placing flat metal plates on the substrate or using a mil-thickness gage especially manufactured for the purpose.

3.4.3 Flood Test

After application and curing is complete, plug drains and fill waterproofed area with water to a depth of 2 inches. A minimum 48 hour cure time, or longer cure time if recommended by the membrane manufacturer, shall be required prior to flood testing. Allow water to stand 24 hours. Test watertightness by measuring water level at beginning and end of the 24 hour period. If water level falls, drain water, allow installation to dry, and inspect. Make repairs or replace as required and repeat the test. Work shall not proceed before approval of repairs or replacement.

3.5 INFORMATION CARD

Furnish a typewritten card containing information listed in the attached Form 1, framed in a watertight frame under clear glass or plastic for each waterproofing installation. Furnish framed card and duplicate card.

FORM 1

FLUID-APPLIED WATERPROOFING SYSTEM COMPONENTS

1. Contract Number

2. Date Work Completed

3. Project Specification Designation

4. Substrate Material

5. Slope of Substrate

6. Drains Type/Manufacturer

7. Waterproofing
   a. Membrane
   b. Sealant
   c. Elastomeric Sheet
   d. Materials Manufacturer(s)

8. Protection Board
   a. Type
   b. Thickness
   c. Manufacturer's Name

9. Drainage Course Material Graduation

10. Insulation
    a. Type
    b. Thickness
    c. Manufacturer's Name

11. Protection Slab
    a. Material
    b. Thickness
    c. Support
    d. Joint System

12. Wearing Course
    a. Type
    b. Slope
    c. Joint System
    d. Sealant/Gasket Type

13. Wearing Surface Type
    Manufacturer's Name

14. Statement of Compliance or Exception

Contractor's Signature Date Signed

Inspector's Signature Date Signed

-- End of Section --

SECTION 07 16 19

METALLIC OXIDE WATERPROOFING

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 33	(2003) Standard Specification for Concrete Aggregates

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Metallic waterproofing

SD-06 Test Reports

Iron content of metallic waterproofing

Oxidizing agent content of metallic waterproofing

Provide certified statement attesting that chemical and physical composition of metallic waterproofing material have been determined by specified testing methods and material has been found to conform with specification requirements.

SD-08 Manufacturer's Instructions

Mixing

1.3 TESTING OF SAMPLES

Prepare a 100 gram sample. Using a magnet over a watch glass, transfer magnetic portion into separate pile leaving nonmagnetic behind. Weigh nonmagnetic portion.

a. Total iron content: Determine total iron by percentage of sample weight using standard qualitative chemical analysis procedures.

b. Oxidizing agent content: Determine percentage of oxidizing agent by standard qualitative chemical analysis technique.

1.4 SAMPLE INSTALLATION

After submittals are approved and before work is started apply metallic waterproofing to a test area not less than 100 square feet, using methods and materials specified herein. Location to be selected by Contracting Officer. Waterproofing shall be visually and physically examined for bond and loose materials by waterproofing materials manufacturer or his representative. A wide-blade putty knife or similar tool will be used for inspection of bond. Failure of waterproofing to bond or appearance of excessive loose materials will be cause for disapproval of proposed material and method of application. Clean disapproved test area free of applied finish, leaving base clean and acceptable for new application. If test area is disapproved, make an additional test area. Do not apply waterproofing in other areas until application of test area has been approved by waterproofing materials manufacturer or his representative, and accepted by Contracting Officer. Approved installation shall remain in place and open to observation as criteria for all metallic waterproofing under contract.

1.5 DELIVERY AND STORAGE

Deliver materials to project site in original sealed containers with manufacturer's name and brand clearly identified. Store in dry locations with adequate ventilation and handle in a manner to prevent damage or contamination.

1.6 ENVIRONMENTAL CONDITIONS

Enclose or protect surfaces to be treated from excessive temperature changes. Ambient temperature shall be above 50 degrees F during application and for duration of curing period. Keep water level below location of surfaces being treated until completion of the treatment and curing period. Provide adequate ventilation to properly oxidize metallic waterproofing.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT

ASTM C 150, Type I.

2.2 FINE AGGREGATE

ASTM C 144 (sand) for waterproofing coats and ASTM C 33 for protective coat.

2.3 WATER

Potable and free from injurious amounts of oil, alkalis, acids, organic matter, and other deleterious substances.

2.4 METALLIC WATERPROOFING COMPOUND

Clean, commercial, pulverized cast iron mixed in dust-confining container with chemical oxidizing agent such as sodium peroxide, potassium peroxide, or ammonium chloride.

2.4.1 Pulverized Cast Iron

85 percent minimum by weight of metallic iron of magnetic portion. Chemical oxidizing agent content shall be a minimum of 3 percent and a maximum of 5 percent by weight of compound. Presence of dirt, paraffin, bitumen, or other foreign substances in excess of one percent by weight of waterproofing compound will be cause for rejection.

2.4.2 Iron Oxide Content

Do not exceed 5 percent by weight of magnetic iron. The magnetic portion of iron shall not contain more than 0.05 percent by weight of oil.

2.4.3 Magnetic Iron Particles

Graded as follows:

Sieve size	Percent passing
No. 20 screen	100
No. 35 screen	95 to 100
No. 40 screen	90 to 100
No. 60 screen	65 to 100
No. 100 screen	45 to 70
No. 200 screen	10 to 25

2.5 CALKING

Polyurethane foam sealant.

PART 3 EXECUTION

3.1 SURFACE CONDITION

Examine all surfaces to be waterproofed to ensure that concrete has properly cured, all shrinkage has occurred, laitance has been removed, cracks and honeycombs have been cut out and filled, and surfaces have been roughened to provide bond for waterproofing material. Correct all defects that will adversely affect proper completion of waterproofing.

3.2 SURFACE PREPARATION

3.2.1 Concrete Surfaces

Roughen concrete wall and floor surfaces by light bushhammering, sandblasting, acid etching, or high pressure water cleaning to provide firm, unspalled granular surface, clean and free from loose materials, debris, and detrimental substances such as dust, dirt, oil, grease, or other coatings. Cut out wire ties to depth of 1 1/2 inches. Cut out holes, honeycombs, open joints, and porous areas. Make all cuts square to a depth of 1 to 1 1/2 inches. Do not cut V-grooves or cone-shaped recesses.

3.2.2 Walls

Clean wall areas that have been cut out, moisten with water, and fill flush with a stiff mortar mix composed of one 94 pound sack of portland cement, 188 pounds of sand, and 15 pounds of metallic oxide waterproofing compound. Apply filling and patching in layers not exceeding 3/4 inch thickness, worked into voids, compacted, and finished flush with adjacent surfaces. Roughen patched areas to provide level, firm, granular surface.

3.2.3 Grooves, Joints, and Intersections

Strip, clean, and remove all loose material from construction joints, grooved recesses, and intersections of vertical and horizontal surfaces. Pack joints with waterproofing mortar mixed in proportions of one 94 pound sack of portland cement and 188 pounds of sand, and 15 pounds of metallic oxide waterproofing compound. Finish compacted mortar flush with adjacent surfaces; finish internal angles to a round cove. Grooves in construction joints, at intersections of horizontal and vertical surfaces, and fillers and water stops for expansion and contraction joints are as indicated.

3.2.4 Calking

Apply calking around all drains, pipes, and other items which penetrate the surfaces to be waterproofed.

3.2.5 Recesses

Waterproof recesses, but do not fill to a lesser opening than detailed.

3.2.6 Penetrations

Do not apply waterproofing until anchorage items or other items passing through or protruding from the surfaces have been installed. Treatment shall be completed and approved prior to attachment of utilities to anchorage items.

3.3 MIXING

Follow mixing instructions supplied by the manufacturer.

3.4 APPLICATION

3.4.1 Limits of Application

Completely coat columns integral with exterior walls. Return wall waterproofing at least 24 inches on interior concrete walls and 48 inches onto masonry walls that are in place at the time of the waterproofing application. Return floor waterproofing at least 12 inches vertically up on the face of all interior walls, partitions, and interior columns in place at the time of waterproofing application.

3.4.2 Walls and Columns

Thoroughly dampen surfaces to receive waterproofing. Apply two coats of thick slurry to each 100 square feet of surface: first coat, consisting of 94 pounds of portland cement, 188 pounds of sand, and 10 pounds of metallic oxide waterproofing compound; second coat, same mix as first coat except with 8 pounds of metallic oxide waterproofing for each 94 pounds of cement. Apply each coat by brushing with stiff bristle brushes to seal all

pores. Allow sufficient time between coats to permit oxidation of material, but not more than 24 hours before application of subsequent treatment. Periodically spray each coat with fine fog spray during oxidation period to ensure thorough curing. Where air circulation is insufficient to properly oxidize waterproofing, provide fans or other means to ensure adequate circulation.

3.4.3 Floors

After surfaces are roughened and properly prepared, thoroughly wash and clean all surfaces prior to application of waterproofing treatment. Apply two coats of thick slurry as previously specified for walls and columns, each coat thoroughly scrubbed and broomed to completely coat floor surface.

3.4.4 Bond Coat

Prior to application of plaster, cement mortar topping, or similar wall and floor finishes specified in other sections, of protective finish coating specified herein apply a bond coat of metallic oxide waterproofing mixed in same proportions as specified for second coat on walls and columns. Prior to bond coat application, thoroughly broom previously treated surfaces with thick bristle brooms to remove all traces of unoxidized compound, and dampen with water. Apply bond coat immediately before finish coat so there will be no premature curing or setting of bond coat before finish coat is applied.

3.4.5 Protective Finish Coating

Waterproofed surfaces which are not to receive plaster, floor topping, or other finish shall receive a protective coating applied directly over the bond coat.

3.4.5.1 Walls and Columns

After application of bond coat, apply protective coating to minimum thickness of 1/8 inch. Mix coating in proportions by volume of one part portland cement to two and one-half parts fine aggregate conforming to ASTM C 33. Float to smooth, even surface.

3.4.5.2 Floors

After application of bond coat, apply protective topping of 1 1/2 inch minimum thickness, consisting of one part portland cement, one part sand, and two parts fine aggregate conforming to ASTM C 33 and proportioned by volume. Mixing shall be done in a mechanical batching-type mixer for not less than 3 minutes after all materials have been included, using not more than 4 gallons of water for each bag of cement when floating is done by machine and 5 gallons for each bag of cement when floating is done by hand. After screeding to established finish lines and levels, compact and then float with wood floats or power floating machines. After finish has sufficiently hardened to prevent excess fine material from being worked to surface, steel trowel to obtain smooth surface free from defects and blemishes. After topping has set to ring, trowel again to a burnished finish.

3.4.5.3 Curing

Protect finish coating from loss of moisture and cure by periodic fog spraying and cover with impervious sheeting or other approved method until

coating has set.

-- End of Section --

SECTION 07 17 00

BENTONITE WATERPROOFING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 217	(2002) Cone Penetration of Lubricating Grease

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-08 Manufacturer's Instructions

Application

Protection

Corrections

1.3 DELIVERY, STORAGE, AND HANDLING

Do not place bentonite waterproofing materials in flooded areas or during precipitation. Provide bentonite panels and containers with manufacturer's labels intact, identifying the materials. Keep materials dry prior to use with polyethylene or canvas covering for sides and top and chocks or skids underneath, of sufficient height to maintain separation from ground water. Protect materials from moisture. Remove materials which show evidence of damage, deterioration, or contamination.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bulk and Panel

Provide high-swelling, sodium bentonite containing a minimum of 90 percent montmorillonite and a maximum of 10 percent unaltered volcanic ash or other native sediments.

2.1.2 Bentonite

Provide material meeting the following requirements:

2.1.2.1 Free Swell Rating

Two grams of granular bentonite sifted into deionized water shall swell to occupy a minimum volume of 16 cubic centimeters.

2.1.2.2 Active Ingredient

Hydrous silicate of alumina, composed of the following chemical percentages and their allowable deviations:

Silica	61.0 +- 3.0
Alumina	19.5 +- 1.5
Iron oxide	5.0 +- 1.0
Magnesia	2.8 +- 0.4
Soda and potash oxides	2.4 +- 0.7
Calcium oxide	0.6 +- 0.5
Molecular water	6.1 +- 0.6
Minor	2.6 +- 0.6

2.1.3 Bentonite Panels

Provide panels containing bentonite material sealed between two layers of absorbent material, with a minimum of one pound of evenly distributed bentonite per square foot. The bentonite panels shall be 48 inches square by a minimum of 3/16 inch thick, in dry state.

2.1.4 Bentonite Mineral-Base Jelly

Provide material meeting requirements of ASTM D 217 for a worked penetration range of 215 to 275. Jelly shall contain 45 percent controlled, partially hydrated, high-swelling sodium bentonite by weight with minimum pH. of 8.8, no free water, and 25 percent or more residual swell.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Examine surfaces prior to treatment, eliminating irregularities and removing loose and foreign material. Remove form tie rods. Point cracks and honeycombs in concrete surfaces. Surfaces of finished patches shall be flush with adjacent concrete surfaces. Allow cement mortar to dry for minimum of 72 hours prior to application of bentonite panels.

3.2 APPLICATION

Apply bentonite waterproofing on exterior surfaces of below grade masonry and concrete walls and wall footings and under concrete slabs, pile caps, grade beams, footings, elevator pits and against bulkhead walls where indicated, in accordance with manufacturer's printed instructions. Securely fasten panels over all construction joints and all expansion joints. Thoroughly pack all through-wall openings and penetrations with bentonite gel or granular bentonite, or both, prior to placement of bentonite panels.

3.3 PROTECTION

Provide protection to bentonite panels during backfilling and compaction as recommended by manufacturer of bentonite materials. If backfill is not immediately applied, protect panels against precipitation by covering temporarily with polyethylene. Replace damaged panels with new panels before and during backfilling and compaction. Compact backfill to at least 85 percent of ASTM D 1557 maximum density.

3.4 CORRECTIONS

Repair leaks and defective areas in accordance with manufacturer's recommendations.

-- End of Section --

SECTION 07 19 00

WATER REPELLENTS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2005) Methods of Test for Exterior Walls

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 259	(2002; R 2006) Resistance of Concrete to Chloride Ion Penetration
AASHTO T 260	(1997; R 2005) Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 140	(2007a) Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 642	(2006) Density, Absorption, and Voids in Hardened Concrete
ASTM C 672/C 672M	(2003) Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
ASTM D 1653	(2003) Water Vapor Transmission of Organic Coating Films
ASTM D 2369	(2007) Volatile Content of Coatings
ASTM D 3278	(1996; R 2004e1) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM E 514	(2006) Water Penetration and Leakage Through Masonry
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000 Air Contaminants

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Water repellents

SD-06 Test Reports

Water absorption

Accelerated weathering

Resistance to chloride ion penetration

Moisture vapor transmission

Scaling resistance

Water Penetration and Leakage

SD-07 Certificates

Manufacturer's qualifications

Applicator's qualifications

Evidence of acceptable variation

Warranty

SD-08 Manufacturer's Instructions

Application instructions

Provide manufacturer's instructions including preparation, application, recommended equipment to be used, safety measures, and protection of completed application.

Manufacturer's material safety data sheets

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

a. Manufacturer's qualifications: Minimum five years record of successful in-service experience of water repellent treatments manufactured for concrete, concrete masonry, plaster application.

b. Applicator's qualifications: Minimum five years successful experience in projects of similar scope using specified or similar treatment materials and manufacturer's approval for application.

1.3.2 Performance Requirements

a. Water absorption: ASTM C 140. Comparison of treated and untreated specimens.

b. Moisture vapor transmission: ASTM E 96/E 96M. Comparison of treated and untreated specimens.

c. Water penetration and leakage through masonry: ASTM E 514.

1.3.3 Evidence of Acceptable Variation

If a product proposed for use does not conform to requirements of the referenced specification, submit for approval to the Contracting Officer, evidence that the proposed product is either equal to or better than the product specified. Include the following:

a. Identification of the proposed substitution;

b. Reason why the substitution is necessary;

c. A comparative analysis of the specified product and the proposed substitution, including tabulations of the composition of pigment and vehicle;

d. The difference between the specified product and the proposed substitution; and

e. Other information necessary for an accurate comparison of the proposed substitution and the specified product.

1.4 SAMPLE TEST PANEL

The approved Sample Test Panel will serve as the standard of quality for all other water repellent coating work. Do not proceed with application until the sample panel has been approved by the Contracting Officer.

1.4.1 Sample Test Panel

Prior to commencing work, including bulk purchase and delivery of material, apply water repellent treatment to a minimum 4 feet high by 4 feet long concrete, concrete masonry, plaster test-panel specified in Section 04 20 00 MASONRY. Provide a full height expansion joint at mid-panel length. Prepare and seal joint with materials approved for project use.

1.4.1.1 Testing

AAMA 501.1 Provide field water testing of water repellent treated surfaces in the presence of the Contracting Officer and the water repellent treatment manufacturer's representative.

a. Apply water repellent to left side of mock-up and allow to cure prior to application of treatment to right side.

b. Twenty days after completion of application of treatment, test mock-up with 5/8 inch garden hose, with spray nozzle, located 10 feet from wall and aimed upward so water strikes wall at 45 degree downward angle. After water has run continuously for three hours

observe back side of mock-up for water penetration and leakage. If leakage is detected make changes as needed and retest.

c. Coordinate testing procedures and modify project treatment application as required to pass mock-up tests for water penetration and leakage resistance.

1.4.1.2 Approval

Proceed with water repellent treatment work only after completion of field test application and approval of mock-up and tests by the Contracting Officer.

1.4.2 Pre-Installation Meeting

a. Attend pre-installation meeting required prior to commencement of concrete, concrete masonry, plaster installation.

b. Review procedures and coordination required between water repellent treatment work and work of other trades which could affect work to be performed under this section of the work.

c. Convene additional pre-installation meeting prior to water repellent treatment application for coordination with work not previously coordinated including joint sealants.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified in Section 01 57 19.00 20 TEMPRARY ENVIRONMENTAL CONTROLS for environmental protection, provide coating materials that conform to the restrictions of the Local Air Pollution Control jurisdiction. Notify the Contracting Officer of any water repellent coating specified herein which fails to conform to the local Air Quality Management District Rules at the location of the Project. In localities where the specified coating is prohibited, the Contracting Officer may direct the substitution of an acceptable coating.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in original sealed containers, clearly marked with the manufacturer's name, brand name, type of material, batch number, percent solids by weight and volume, and date of manufacturer. Store materials off the ground, in a dry area where the temperature will be not less 50 degrees F nor more than 85 degrees F.

1.7 SAFETY METHODS

Apply coating materials using safety methods and equipment in accordance with Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS, and the following:

1.7.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The coating manufacturer when using solvents or other chemicals.

Use impermeable gloves, chemical goggles or face shield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct work in a manner to minimize exposure of building occupants and the general public.

b. 29 CFR 1910.1000.

c. Threshold Limit Values (R) of the American Conference of Governmental Industrial Hygienists.

d. Manufacturer's material safety data sheets.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Weather and Substrate Conditions

Do not proceed with application of water repellents under any of the following conditions, except with written recommendations of manufacturer.

a. Ambient temperature is less than 40 degrees F.

b. Substrate faces have cured less than one month.

c. Rain or temperature below 40 degrees F are predicted for a period of 24 hours before or after treatment.

d. Earlier than three days after surfaces are wet.

e. Substrate is frozen or surface temperature is less than 40 degrees F and falling.

1.8.2 Moisture Condition

Determine moisture content of substrate meets manufacturer's requirements prior to application of water repellent material.

1.9 SEQUENCING AND SCHEDULING

1.9.1 Masonry Surfaces

Do not start water repellent coating until all joint tooling, pointing and masonry cleaning operations have been completed. Allow masonry to cure for at least 60 days under normal weather conditions before applying water repellent.

1.9.2 Plaster Surfaces

Do not start water repellent coating until all shrinkage and stress cracks are repaired and sound, all surfaces are free of defects and cleaning operations have been completed. Allow plaster to cure for at least 30 days under normal weather conditions before applying water repellent.

1.9.3 Concrete Surfaces

Do not start water repellent coating until all patching, pointing and cleaning operations have been completed and concrete has cured a minimum of 30 days under normal weather conditions.

1.9.4 Sealants

Do not apply water repellents until the sealants for joints adjacent to surfaces receiving water repellent treatment have been installed and cured.

a. Water repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

b. Provide manufacturers' test results of compatibility.

1.10 INSPECTIONS

Notify the manufacturer's representative a minimum of 72 hours prior to scheduled application of water repellents for field inspection. Inspect surfaces and obtain approval in writing from the manufacturer's representative prior to any application of any water repellent coating.

1.11 SURFACES TO BE COATED

Coat all exterior concrete, masonry, or plaster surfaces. This includes back faces of parapets, top of walls, edges and returns adjacent to windows and door frames and free standing walls.

1.12 WARRANTY

Provide a warranty, issued jointly by the manufacturer and the applicator of the water repellent treatment against moisture penetration through the treated structurally sound surface for a period of five years. Warranty to provide the material, labor, and equipment necessary to remedy the problem. At the satisfactory completion of the work, complete the warranty sign, notarize, and submit to the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

Water repellent solution shall be a clear, non-yellowing, deep-penetrating, VOC compliant solution. Material shall not stain or discolor and shall produce a mechanical and chemical interlocking bond with the substrate to the depth of the penetration.

2.2 WATER REPELLENTS

2.2.1 Silane, 20 Percent Solids

Penetrating water repellent. A monomeric compound containing approximately 20 percent alkyltrialkoxysilanes with alcohol, mineral spirits, water, and other proprietary solvent carrier.

a. Composition: Modified alkylalkoxysilane.

b. Active alkylalkoxysilane content: ASTM D 2369 20 percent by weight, plus or minus 1 percent.

c. Appearance: White, milky liquid.

d. Average depth of penetration: Up to 3/8 inchdepending on

substrate.

e. VOC content: Less than 350 grams per liter.

f. Flash point, ASTM D 3278.

g. Specific gravity, at 78 degrees F: 0.96 to 0.98.

h. Density:.0 to 8.2 pounds per gallon.

2.2.2 Silane, 40 Percent Solids

Penetrating water repellent. A monomeric compound containing approximately 40 percent alkyltrialkoxysilanes with alcohol, mineral spirits, or water.

a. Composition: Modified alkylalkoxysilane.

b. Active alkylalkoxysilane content: ASTM D 2369 40 percent by weight, plus or minus 1.5 percent.

c. Appearance: White, milky liquid.

d. Average depth of penetration: Up to 3/8 inch depending on substrate.

e. VOC content: Less than 350 grams per liter.

f. Flash point, ASTM D 3278.

g. Specific gravity, at 78 degrees F: 0.94 to 0.97.

h. Density: 7.8 to 8.1 pounds per gallon.

2.2.3 Silane, 85 Percent Solids or Greater

Penetrating water repellent. A monomeric compound containing 85 percent or greater alkyltrialkoxysilanes with alcohol, mineral spirits, or water.

a. Composition: Modified alkylalkoxysilane.

b. Active alkylalkoxysilane content: ASTM D 2369 20 percent by weight, plus or minus 1 percent.

c. Appearance: White, milky liquid.

d. Average depth of penetration: Up to 3/8 inch depending on substrate.

e. VOC content: Less than 350 grams per liter.

f. Flash point, ASTM D 3278.

g. Specific gravity, at 78 degrees F: 0.96 to 0.98

h. Density: 8.0 to 8.2 pounds per gallon.

2.2.4 Siloxanes

Penetrating water repellent. Alkylalkoxysiloxanes that are oligomerous

with alcohol, ethanol, mineral spirits, or water.

a. Solids by weight: ASTM D 2369, 7.5-16.0 percent.

b. Volatile Organic Content (VOC) after blending: Less than 175 grams per liter.

c. Density, activated: 8.4 pounds per gallon, plus or minus one percent.

d. Flash point, ASTM D 3278: Greater than212 degrees F.

2.2.5 Low-Solids Acrylic

Water-clear, breathing coating of acrylic resins, water-based, solvent-based, or acrylic emulsions solution containing less than 15 percent solids by volume.

2.2.6 High-Solids Acrylic

Water-clear, breathing coating of acrylic resins, water-based, solvent-based, or acrylic emulsions solution containing 15 percent solids or more by volume.

2.2.7 VOC-Complying Water Repellents

Products certified by the manufacturer that they comply with local regulations controlling use of volatile organic compounds (VOC's).

2.3 PERFORMANCE CRITERIA

2.3.1 Silane, 20 Percent Solids

a. Water absorption test: ASTM C 642 and ASTM E 514.

b. Moisture vapor transmission: ASTM D 1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces.

c. Scaling resistance: ASTM C 672/C 672M, non-air-entrained concrete, zero rating, no scaling, 100 cycles treated concrete.

d. Resistance to chloride ion penetration: AASHTO T 259 and AASHTO T 260.

e. Water penetration and leakage through masonry, ASTM E 514 percentage reduction of leakage: 97 percent minimum.

f. Resistance to accelerated weathering, ASTM G 53 testing 2,500 hours: No loss in repellency.

g. Drying time under normal conditions: Four hours per 75 degrees F.

2.3.2 Silane, 40 Percent Solids

a. Average depth of penetration: 3/8 inches depending on substrate

b. Resistance to chloride ion penetration, AASHTO T 259 and AASHTO T 260.

c. Water absorption test, ASTM E 514: 0.42 percent per 48 hours; 1.2 percent per 50 days.

d. Moisture vapor transmission: ASTM D 1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces.

e. Scaling resistance, ASTM C 672/C 672M, non-air-entrained concrete: Zero rating, no scaling, 100 cycles treated concrete.

f. Resistance to accelerated weathering, ASTM G 53. Testing 2,500 hours: No loss in repellency.

g. Drying time under normal conditions: Four hours per 75 degrees F.

2.3.3 Silane, 85 Percent Solids or Greater

a. Average depth of penetration: 3/8 inches depending on substrate

b. Resistance to chloride ion penetration, AASHTO T 259 and AASHTO T 260.

c. Water absorption test, ASTM E 514: 0.42 percent per 48 hours; 1.2 percent per 50 days.

d. Moisture vapor transmission: ASTM D 1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces.

e. Scaling resistance, ASTM C 672/C 672M, non-air-entrained concrete: Zero rating, no scaling, 100 cycles treated concrete.

f. Resistance to accelerated weathering, ASTM G 53. Testing 2,500 hours: No loss in repellency.

g. Drying time under normal conditions: Four hours per 75 degrees F.

2.3.4 Siloxanes

a. Dry time for recoat, if necessary: One to two hours depending on weather conditions.

b. Penetration: 3/8 inch, depending on substrate.

c. Water penetration and leakage through masonry, ASTM E 514, percentage reduction of leakage: 97.0 percent minimum

d. Moisture vapor transmission, ASTM E 96/E 96M: 47.5 perms or 82 percent maximum compared to untreated sample.

e. Resistance to accelerated weathering, ASTM G 53. Testing 2,500 hours: No loss in repellency.

f. Resistance to chloride ion penetration, AASHTO T 259 and AASHTO T 260.

g. Scaling resistance,ASTM C 672/C 672M, non-air-entrained concrete: Zero rating, no scaling, 100 cycles treated concrete.

PART 3 EXECUTION

3.1 EXAMINATION

Examine concrete, plaster, or masonry surfaces to be treated to ensure that:

a. All visible cracks, voids or holes have been repaired.

b. All mortar joints in masonry are tight and sound, have not been re-set or misaligned and show no cracks or spalling.

c. Moisture contents of walls does not exceed 15 percent when measured on an electronic moisture register, calibrated for the appropriate substrate.

d. Concrete surfaces are free of form release agents, curing compounds and other compounds that would prevent full penetration of the water repellent material.

Do not start water repellent treatment work until all deficiencies have been corrected, examined and found acceptable to the Contracting Officer and the water repellent treatment manufacturer. Do not apply treatment to damp, dirty, dusty or otherwise unsuitable surfaces. Comply with the manufacturer's recommendations for suitability of surface.

3.2 PREPARATION

3.2.1 Surface Preparation

Prepare substrates in accordance with water repellent treatment manufacturer's recommendation. Clean surfaces of dust, dirt, efflorescence, alkaline, and foreign matter detrimental to proper application of water repellent treatment.

3.2.2 Protection

Provide masking or protective covering for materials which could be damaged by water repellent treatment.

a. Protect glass, glazed products, and prefinished products from contact with water repellent treatment.

b. Protect landscape materials with breathing type drop cloths: plastic covers are not acceptable.

3.2.3 Compatibility

a. Confirm treatment compatibility with each type of joint sealer within or adjacent to surfaces receiving water repellent treatment in accordance with manufacturer's recommendations.

b. When recommended by joint sealer manufacturer, apply treatment after application and cure of joint sealers. Coordinate treatment with joint sealers.

c. Mask surfaces indicated to receive joint sealers which would be adversely affected by water repellent treatment where treatment must be applied prior to application of joint sealers.

3.3 MIXING

Mix water repellent material thoroughly in accordance with the manufacturer's recommendations. Mix, in quantities required for that days work, all containers prior to application. Mix each container the same length of time.

3.4 APPLICATION

In strict accordance with the manufacturers written requirements. Do not start application without the manufacturer's representative being present or his written acceptance of the surface to be treated.

3.4.1 Water Repellent Treatment

3.4.1.1 Spray Application

Spray apply water repellent material to exterior concrete, plaster, and masonry surfaces using low-pressure airless spray equipment in strict accordance with manufacturer's printed application, instructions, and precautions. Maintain copies at the job site. Apply flood coat in an overlapping pattern allowing approximately 8 to 10 inch rundown on the vertical surface. Maintain a wet edge at all overlaps, both vertical and horizontal. Hold gun maximum 18 inches from wall.

3.4.1.2 Brush or Roller Application

Brush or roller apply water repellent material only at locations where overspray would affect adjacent materials and where not practical for spray applications.

3.4.1.3 Covered Surfaces

Coat all exterior concrete, plaster, or masonry surfaces including back faces of parapets, tops of walls, edges and returns adjacent to window and door frames, window sills, and free-standing walls.

3.4.1.4 Rate of Application

Apply materials to exterior surfaces at the coverages recommended by the manufacturer and as determined from sample panel test. Increase or decrease application rates depending upon the surface texture and porosity of the substrate so as to achieve even appearance and total water repellency.

3.4.1.5 Number of Coats

The sample panel test shall determine the number of coats required to achieve full coverage and protection.

3.4.1.6 Appearance

If unevenness in appearance, lines of work termination or scaffold lines exist, or detectable changes from the approved sample panel occur, the Contracting Officer may require additional treatment at no additional cost to the Government. Apply any required additional treatment to a natural break off point.

3.5 CLEANING

Clean all runs, drips, and overspray from adjacent surfaces while the water repellent treatment is still wet in a manner recommended by the manufacturer.

3.6 FIELD QUALITY CONTROL

Do not remove drums containing water repellent material from the job site until completion of all water repellent treatment and until so authorized by the Contracting Officer.

3.6.1 Field Testing

AAMA 501.1. At a time not less than twenty days after completion of the water repellent coating application, subject a representative wall area of the building to the Navy Hose Stream Field Test similiar to AAMA 501.1 hose test to simulated rainfall for a period of three hours. Use a minimum 5/8 inch diameter hose and a fixed lawn sprinkler spray head which will direct a full flow of water against the wall. Place the sprinkler head so that the water will strike the wall downward at a 45 degree angle to the wall. If the inside of the wall shows any trace of moisture during or following the test, apply another coat of water repellent, at the manufacturer's recommended coverage rate to the entire building. Repeat testing and re-coating process until no moisture shows on the inside wall face. Accomplish any required work retesting and re-coating at no additional cost to the Government.

3.6.2 Site Inspection

Inspect treatment in progress by manufacturer's representative to verify compliance with manufacturer instructions and recommendations.

-- End of Section --

SECTION 07 21 13

BOARD AND BLOCK INSULATION

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1289	(2007) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 165	(2007) Standard Test Method for Measuring Compressive Properties of Thermal Insulations
ASTM C 203	(2005a) Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C 272	(2001; R 2007) Water Absorption of Core Materials for Structural Sandwich Constructions
ASTM C 552	(2007) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 553	(2002) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2007) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2004) Mineral Fiber Block and Board Thermal Insulation
ASTM C 930	(2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 1621	(2004a) Compressive Properties of Rigid Cellular Plastics
ASTM D 3833/D 3833M	(1996; R 2006) Water Vapor Transmission of Pressure-Sensitive Tapes

ASTM D 4397	(2002) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 828	(1997; R 2002) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM E 136	(2004) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 154	(1999; R 2005) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2006) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 31	(2006; Errata 2006; Errata 2007) Installation of Oil Burning Equipment
NFPA 54	(2006) National Fuel Gas Code
NFPA 70	(2007) National Electrical Code - 2008 Edition

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM	(2006) Puncture Test of Container Board

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Block or board insulation

Vapor retarder

Pressure sensitive tape

Protection board or coating

Accessories

SD-08 Manufacturer's Instructions

Block or Board Insulation

Adhesive

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Other Safety Considerations

Consider safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide only thermal insulating materials recommended by manufacturer for type of application indicated. Provide board or block thermal insulation conforming to the following standards and the physical properties listed below:

a. Cellular Glass: ASTM C 552

b. Extruded Preformed Cellular Polystyrene: ASTM C 578

c. Mineral Fiber Block and Board: ASTM C 612

d. Unfaced Preformed Rigid Polyurethane and Polyisocyanurate Board: ASTM C 591

e. Faced Rigid Cellular Polyisocyanurate and Polyurethane Insulation: ASTM C 1289

1. Type I Aluminum Foil on both major surfaces. Class 1 - Non-reinforced core foam. Class 2 - Glass fiber reinforced core.

2. Type II Fibrous felt or glass fiber mat membrane on both major surfaces of the core foam.

3. Type III Perlite insulation board on one major surface of the core foam and a fibrous felt or glass fiber mat membrane on the other major surface of the core foam.

4. Type IV Cellulosic fiber insulating board on the one major surface of the core foam and fibrous felt or glass fiber mat membrane on the other major surface of the core foam.

5. Type V Oriented strand board or water-board on one major surface of the core foam and fibrous felt or glass fiber mat membrane or aluminum foil on the other major surface of the core foam.

6. Type VI Perlite insulation board on both major surfaces of the core foam.

2.1.1 Thermal Resistance

As indicated.

2.1.2 Fire Protection Requirement

a. Flame spread index of 75 or less when tested in accordance with ASTM E 84.

b. Smoke developed index of 200 or less when tested in accordance with ASTM E 84.

2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

a. Rigid cellular plastics: Compressive Resistance at Yield: Not less than 10 pounds per square inch (psi) when measured according to ASTM D 1621.

b. Mineral fiber board: Compressive strength: Minimum load required to produce a reduction in thickness of 10 percent, lbf/sft: 25, 1000 when tested according to ASTM C 165.

b. Flexural strength: Not less than 25 psi when measured according to ASTM C 203.

c. Water Vapor Permeance: Not more than 1.1 Perms or less when measured according to ASTM E 96/E 96M, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.

d. Water Absorption: Not more than 2 percent by total immersion, by volume, when measured according to ASTM C 272.

e. Water Adsorption: Not more than 1 percent by volume when measured

in accordance with paragraph 14 of ASTM C 553.

2.1.4 Premolded Concrete Masonry Insert

ASTM C 578. Install inserts in concrete masonry units at the masonry unit manufacturing plant. Provide insert with thickness not less than 1 1/4 inches.

2.1.5 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section. The minimum required recycled material contents (by weight, not volume) are:

Polyisocyanurate/Polyurethane: 9 percent
Phenolic Rigid Foam : 5 percent
Perlite Board: 23 percent

2.1.6 Prohibited Materials

Do not provide materials containing more than one percent of asbestos.

2.2 VAPOR RETARDER AND DAMPPROOFING

2.2.1 Vapor Retarder in Frame Walls and Roofs

a. 6 mil thick polyethylene sheeting conforming to ASTM D 4397 and having a water vapor permeance of one perm or less when tested in accordance with ASTM E 96/E 96M.

b. Membrane with the following properties:

Water Vapor Permeance: ASTM E 96/E 96M: 1 perm
Maximum Flame Spread: ASTM E 84: 25
Combustion Characteristics: Passing ASTM E 136
Puncture Resistance: TAPPI T803 OM: 15
Tensile Strength: ASTM D 828: 15

2.2.2 Dampproofing for Masonry Cavity Walls

Bituminous material is specified in Section 07 11 13 BITUMINOUS DAMPPROOFING. Parging material is specified in Section 04 20 00 MASONRY.

2.2.3 Vapor Retarder under Floor Slab

a. Water vapor permeance: 0.2 Perm or less when tested in accordance with ASTM E 96/E 96M.

b. Puncture resistance: Maximum load no less than 40 pounds when tested according to ASTM E 154.

2.3 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D 3833/D 3833M.

2.4 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

2.5 ACCESSORIES

2.5.1 Adhesive

As recommended by insulation manufacturer.

2.5.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that all areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If installing perimeter or under slab insulation, check that the fill is flat, smooth, dry, and well tamped. If moisture or other conditions are found that do not allow the proper installation of the insulation, do not proceed but notify the Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Unless using insulation board that passes ASTM E 136 in addition to the requirements in Part 2, install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting products of combustion, flues, and chimneys other than masonry chimneys: minimum clearances as required by NFPA 211.

f. Gas Fired Appliances: Clearances as required in NFPA 54.

g. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking is not required if chimneys or flues are certified by the Manufacturer for use in contact with insulating materials.

3.3 INSTALLATION

3.3.1 Insulation Board

Install and handle insulation in accordance with the manufacturer's installation instructions. Keep material dry and free of extraneous materials. Observe safe work practices.

3.3.2 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.3 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.4 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating any thermal bridges or voids.

3.4 INSTALLATION ON WALLS

3.4.1 Installation using Furring Strips

Install insulation between, on members as recommended by insulation manufacturer.

3.4.2 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Put ends in moderate contact with adjoining insulation without forcing. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other services. Seal around cut-outs with sealant. Install board in wall cavities so that it leaves at least a nominal one inch free air space outside of the insulation to allow for cavity drainage.

Insert premolded or board insulation into masonry unit hollow cores as recommended by the insulation manufacturer.

3.4.3 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

a. Full back bed method or

b. Spot method: Provide at least six spots having diameter of approximately 4 inches, located at each corner and mid-points of each of the longer sides of each board.

c. As recommended by the insulation manufacturer.

d. Use only full back method for pieces of one square foot or less.

e. Butt all edges of insulation and seal edges with tape.

3.4.4 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners, bend split prongs flush with insulation. Butt all edges of insulation and seal with tape.

3.4.5 Protection Board or Coating

Install protection board or coating in accordance with manufacturer's instructions. Install protection over all exterior exposed insulation board and down to 1 foot below grade.

3.5 INSTALLATION ON UNDERSIDE OF CONCRETE FLOOR SLAB

3.5.1 Mechanically Fastened Systems

Size insulation to cover underside of slab. Apply adhesive to slab and set fasteners in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners, bend split prongs flush with insulation. Butt all edges of insulation and seal with tape.

3.5.2 Adhesively Bonded Systems

Apply adhesive to underside of the and completely cover wall with insulation.

a. Full back bed method or

b. Spot method: Provide at least six spots having a diameter of approximately 4 inches, located at each corner and mid-point of each of the longer sides.

c. As recommended by insulation manufacturer.

d. Use full back method for insulation pieces one square foot or less.

e. Butt all edges of insulation and seal with tape.

3.6 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls or slab edges in slab-on-grade or floating-slab construction.

3.6.1 Manufacturer's Instructions

Install, attach, tape edges, provide vapor retarder and other requirements such as protection against vermin, insects, damage during construction as recommended in manufacturer's instructions.

3.6.2 Insulation on Vertical Surfaces

Install thermal insulation as indicated, on exterior of foundation walls, on grade beams, partially, below grade, and on edges of slabs on grade. Fasten insulation with adhesive or mechanical fasteners.

3.6.3 Insulation Under Slab

Provide insulation horizontally under entire slab on grade for a distance of 2 feet from the edge of slab, as indicated. Turn insulation up at slab edge, and extend full height of slab. Install insulation on top of vapor retarder and turn retarder up over the outside edge of insulation to top of slab.

3.6.4 Protection of Insulation

Protect insulation on vertical surfaces from damage during construction and back filling by application of protection board or coating. Do not leave installed vertical insulation unprotected overnight. Install protection over entire exposed exterior insulation board. Provide protection extending at least one foot below grade.

3.7 VAPOR RETARDER

Apply a continuous vapor retarder as indicated. Overlap all joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

3.8 ACCESS PANELS AND DOORS

Affix insulation to all access panels greater than one square foot and all access doors in insulated floors and ceilings. Use insulation with same R-Value as that for floor or ceiling.

-- End of Section --

SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 665	(2006) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 930	(2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 3833/D 3833M	(1996; R 2006) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	(2002) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 828	(1997; R 2002) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM E 136	(2004) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2006) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 31	(2006; Errata 2006; Errata 2007) Installation of Oil Burning Equipment
NFPA 54	(2006) National Fuel Gas Code
NFPA 70	(2007) National Electrical Code - 2008 Edition

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM (2006) Puncture Test of Container Board

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134 Respiratory Protection

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Blanket insulation

Sill sealer insulation

Vapor retarder

Pressure sensitive tape

Accessories

SD-08 Manufacturer's Instructions

Insulation

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

ASTM C 665, Type I, blankets without membrane coverings and II, blankets with non-reflecting coverings and III, blankets with reflective coverings; Class A, membrane-faced surface with a flame spread of 25 or less B, membrane-faced surface with a flame propagation resistance; critical radiant flux of 0.11 Btu/ft2 or greater, except a flame spread rating of 25, 75, 100 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84.

2.1.1 Thermal Resistance Value (R-VALUE)

As indicated

2.1.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:

Rock Wool: 75 percent slag
Fiberglass: 20 to 25 percent glass cullet

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.2 SILL SEALER INSULATION

ASTM C 665, Type I.

2.3 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C 665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E 136 for blocking around chimneys and heat producing devices.

2.4 VAPOR RETARDER

a. 6 mil thick polyethylene sheeting conforming to ASTM D 4397 and having a water vapor permeance of 1 perm or less when tested in accordance with ASTM E 96/E 96M.

b. Membrane with the following properties:

Water Vapor Permeance: ASTM E 96/E 96M: 1 perm
Maximum Flame Spread: ASTM E 84: 25
Combustion Characteristics: Passing ASTM E 136

Puncture Resistance: TAPPI T803 OM: 15, 25, 50
Tensile Strength: ASTM D 828: 15, 20, 35

2.5 PRESSURE SENSITIVE TAPE

As recommended by the vapor retarder manufacturer and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D 3833/D 3833M.

2.6 ACCESSORIES

2.6.1 Adhesive

As recommended by the insulation manufacturer.

2.6.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.6.3 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking at Attic Vents and Access Doors

Prior to installation of insulation, install permanent blocking to prevent insulation from slipping over, clogging, or restricting air flow through soffit vents at eaves. Install permanent blocking around attic trap doors. Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

f. Gas Fired Appliances: Clearances as required in NFPA 54.

g. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking around flues and chimneys is not required when insulation blanket, including any attached vapor retarder, passed ASTM E 136, in addition to meeting all other requirements stipulated in Part 2. Blocking is also not required if the chimneys are certified by the manufacturer for use in contact with insulating materials.

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Where insulation required is thicker than depth of joist, provide full width blankets to cover across top of joists. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.3.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.3.1.4 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.1.5 Insulation Blanket with Affixed Vapor Retarder

Locate vapor retarder as indicated. Do not install blankets with affixed vapor retarders unless so specified. Unless the insulation manufacturer's instructions specifically recommend not to staple the flanges of the vapor retarder facing, staple flanges of vapor retarder at 6 inch intervals flush with face or set in the side of truss, joist, or stud. Avoid gaps and bulges in insulation and "fishmouth" in vapor retarders. Overlap both flanges when using face method. Seal joints and edges of vapor retarder with pressure sensitive tape. Stuff pieces of insulation into small cracks between trusses, joists, studs and other framing, such as at attic access

doors, door and window heads, jambs, and sills, band joists, and headers. Cover these insulated cracks with vapor retarder material and tape all joints with pressure sensitive tape to provide air and vapor tightness.

3.3.1.6 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers.

3.3.1.7 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

3.3.1.8 Special Requirements for Ceilings

Place insulation under electrical wiring occurring across joists. Pack insulation into narrowly spaced framing. Do not block flow of air through soffit vents. Attach insulation to attic door by adhesive or staples.

3.3.1.9 Installation of Sill Sealer

Size sill sealer insulation and place insulation over top of masonry or concrete perimeter walls or concrete perimeter floor slab on grade. Fasten sill plate over insulation.

3.3.1.10 Special Requirements for Floors

Hold insulation in place with corrosion resistant wire mesh, wire fasteners, or wire lacing.

3.3.1.11 Access Panels and Doors

Affix blanket insulation to access panels greater than one square foot and access doors in insulated floors and ceilings. Use insulation with same R-Value as that for floor or ceiling.

3.3.2 Installation of Separate Vapor Retarder

Apply continuous vapor retarder as indicated. Overlap joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

-- End of Section --

SECTION 07 21 23

LOOSE FILL THERMAL INSULATION

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1015	(2006) Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation
ASTM C 516	(2002) Vermiculite Loose Fill Thermal Insulation
ASTM C 549	(2006) Perlite Loose Fill Insulation
ASTM C 665	(2006) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 739	(2005be1) Cellulosic Fiber Loose-Fill Thermal Insulation
ASTM C 764	(2007) Mineral Fiber Loose-Fill Thermal Insulation
ASTM C 930	(2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 3833/D 3833M	(1996; R 2006) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	(2002) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 136	(2004) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2006) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

NFPA 31	(2006; Errata 2006; Errata 2007) Installation of Oil Burning Equipment
NFPA 54	(2006) National Fuel Gas Code
NFPA 70	(2007) National Electrical Code - 2008 Edition

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1209	Interim Safety Standard for Cellulose Insulation
16 CFR 1404.4	Requirements to Provide Performance and Technical Data by Labeling - Notice to Purchasers
29 CFR 1910.134	Respiratory Protection

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Loose fill insulation

Sill sealer insulation

Vapor retarder

Pressure sensitive tape

SD-08 Manufacturer's Instructions

Loose Fill Insulation

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to the site in original sealed containers or packages, each bearing manufacturer's name and brand designation, referenced specification number, type, and class, as applicable; recommended method of installation (pneumatic or pouring); minimum net weight of insulation; coverage charts; R-values; and, for cellulose insulation, a label certifying that the product meets Consumer Product Safety Commission (CPSC) Interim Safety Standard for Cellulose Insulation, 16 CFR 1209, and cautionary label regarding potential fire hazard as required in 16 CFR 1404.4.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of loose fill thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930

PART 2 PRODUCTS

2.1 LOOSE FILL INSULATION

Provide loose fill insulation conforming to one of the following:

a. Mineral Fiber Loose Fill: ASTM C 764, Type I, for pneumatic application, or II, for poured application, category 1, 2, as indicated.

b. Cellulosic or Wood Fiber Loose Fill: ASTM C 739 or 16 CFR 1209.

c. Granular Mineral Loose Fill: ASTM C 516 type II vermiculite or ASTM C 549 types II or IV perlite.

2.1.1 Thermal Resistance Value(s) (R-Values)

The R-Value shall be as indicated. The R-value shall be the value the product achieves after settlement.

2.1.2 Recycled Material

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all the other requirements of this section. At the minimum, the recycled material content shall be:

Rockwool: 75 percent slag
Fiberglass: 20 to 25 percent glass cullet
Cellulose: 75 percent post-consumer paper

2.1.3 Prohibited Materials

a. Asbestos-containing materials.

b. Urea Formaldehyde containing materials

c. Ammonium Sulfate containg material

2.2 SILL SEALER INSULATION

ASTM C 665, Type I.

2.3 BLOCKING

Wood, metal, unfaced mineral fiber blanket material in accordance with ASTM C 665, Type I, or other approved materials. Provide only non-combustible materials (based on determination by ASTM E 136 for blocking around chimneys and heat producing devices.

2.4 VAPOR RETARDER

a. 6 mil thick polyethylene sheeting conforming to ASTM D 4397 and having a water vapor permeance of one perm (grains/(h*ft2*in.Hg) or less when tested in accordance with ASTM E 96/E 96M.

b. Membrane as indicated

2.5 PRESSURE SENSITIVE TAPE

As recommended by the vapor retarder manufacturer and having a water vapor permeance rating of one perm (grains/h*ft2*in.hg) or less when tested in accordance with ASTM D 3833/D 3833M.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, verify that all areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify the Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking at Attic Vents and Access Doors

Prior to installation of insulation, install permanent blocking to prevent insulation from covering, clogging, or restricting air flow through soffit vents at eaves. Install permanent blocking around attic trap doors. Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: minimum clearances as required by NFPA 211.

f. Gas fired appliances: Clearances as required in NFPA 54.

g. Oil fired appliances: Clearances as required in NFPA 31.

Blocking around flues and chimneys is not required if the insulation and vapor retarder, when provided, passed ASTM E 136, in addition to meeting all other requirements stipulated in Part 2. The blocking is also not required when chimneys are certified by the manufacturer for use in contact with insulating materials.

3.2.3 Protection of Ventilation System

Prior to installation of insulation, inspect existing HVAC equipment and ductwork to ensure that insulation will not infiltrate the air distribution/ventilation system. Where potential infiltration sources have been identified do not install insulation until repairs/modifications have been made to rectify the problem.

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with applicable provisions of ASTM C 1015, and manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices. Use only pneumatic equipment compatible with insulation material. Operate equipment in accordance with the manufacturer's instructions. Do not tamp or rod insulation. Install insulation using the amount (by weight) of material per square foot required to achieve the specified thermal resistance value.

3.3.2 Attics and Ceilings

Fill space between and above ceiling joists and rafters to provide the specified R-Value. For pneumatic installations, use lowest air pressure allowed by manufacturer's instructions. Do not blow insulation into electrical devices, soffit vents, and mechanical vents which open into attic or other spaces to receive insulation.

3.3.2.1 Frame Walls

Completely fill wall cavities except those which serve as air ducts for heating, ventilating, and air conditioning systems. Locate entry holes in walls where required to permit the complete filling of wall cavities. After opening entry holes, check wall cavity for fire stops and other obstructions. When fire stops or other obstructions prevent complete filling of wall cavity, cut additional entry holes to fill the cavity. Close entry holes using materials compatible with original materials. Seal entry holes in locations where they penetrate a vapor retarder.

3.3.2.2 Masonry Walls

Bring up granular insulation in not more than 2 foot lifts as the wall is constructed. Allow the insulation to assume its natural density as it is

placed.

3.3.2.3 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.2.4 Cold Climate Requirement

Place insulation to the outside of all pipes.

3.3.2.5 Special Requirements for Ceilings

Place insulation under electrical wiring occurring across joists. Pack insulation into narrowly spaced framing. Do not block flow of air through soffit vents.

3.3.2.6 Installation of Sill Sealer

Size sill sealer insulation and place insulation over top of masonry or concrete perimeter walls or concrete perimeter floor slab on grade. Fasten sill plate over insulation.

3.3.2.7 Access Panels and Doors

Affix blanket insulation to all access panels and doors greater than one square foot in insulated floors and ceilings. Use insulation with same R-Value as that for floor or ceiling.

3.3.3 Installation of Vapor Retarder

Apply continuous vapor retarder as indicated. Overlap joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape. Do not install vapor retarders on both sides of insulation.

-- End of Section --

SECTION 07 22 00

ROOF AND DECK INSULATION

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1050	(1991) Standard Specification for Rigid Cellular Polystyrene-Cellulosic Fiber Composite Roof Insulation
ASTM C 1177/C 1177M	(2006) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1289	(2007) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 208	(1995; R 2001) Cellulosic Fiber Insulating Board
ASTM C 552	(2007) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 726	(2005) Mineral Fiber Roof Insulation Board
ASTM C 728	(2005) Perlite Thermal Insulation Board
ASTM D 2178	(2004) Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 312	(2000; R 2006) Standard Specification for Asphalt Used in Roofing
ASTM D 41	(2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4586	(2007) Asphalt Roof Cement, Asbestos-Free
ASTM D 4601	(2004) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing

ASTM D 4897	(2001) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM AS 4470	(1986; R 1992) Class I Roof Covers
FM P7825	(2005) Approval Guide
FM P7825c	(2005) Approval Guide Building Materials
FM P9513	(2002) Specialist Data Book Set for Roofing Contractors; contains 1-22 (2001), 1-28 (2002), 1-29 (2002), 1-28R/1-29R (1998), 1-30 (2000), 1-31 (2000), 1-32 (2000), 1-33 (2000), 1-34 (2001), 1-49 (2000), 1-52 (2000), 1-54 (2001)

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2007) Building Materials Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wood nailers

Tapered roof insulation system

Taper cants and crickets

Show location and spacing of wood nailers that are required for securing insulation and for backnailing of roofing felts. Show a complete description of the procedures for the installation of each phase of the system indicating the type of materials, thicknesses, identity codes, sequence of laying insulation, location of ridges and valleys, special methods for cutting and fitting of insulation, and special precautions. The drawings shall be based on field measurements.

SD-03 Product Data

Fasteners, Asphalt

Insulation

Include minimum thickness of insulation for steel and concrete decks and fastener pattern for insulation on steel decks.

SD-06 Test Reports

Flame spread and smoke developed ratings

Submit in accordance with ASTM E 84.

SD-07 Certificates

Installer qualifications

SD-08 Manufacturer's Instructions

Nails and fasteners

Roof insulation, including field of roof and perimeter attachment requirements.

1.3 MANUFACTURER'S CERTIFICATE

Submit certificate from the insulation manufacturer attesting that the installer has the proper qualifications for installing tapered roof insulation systems.

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of recovered material. Certificates of compliance for felt materials.

1.4 QUALITY ASSURANCE

1.4.1 Insulation on Combustible Steel or Concrete Decks

Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and listed in the UL Bld Mat Dir as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL Bld Mat Dir or listed as Class I roof deck construction in the FM P7825. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

1.4.2 Foam Board on Combustible Steel Decks

Separate polyurethane or polystyrene insulation from a combustible steel deck with a thermal barrier of glass mat gypsum roof board or roof insulation in accordance with the requirements of the UL Bld Mat Dir or the FM P7825.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer;

b. Brand designation;

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification; and

d. Asphalt's flashpoint (FP), equiviscous temperature (EVT), and finished blowing temperature (FBT).

Deliver materials in sufficient quantity to allow continuity of the work.

1.5.2 Storage and Handling

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Store felt rolls on ends. For the 24 hours immediately before application of felts, store felts in an area maintained at a temperature no lower than 50 degrees F above grade and having ventilation around all sides. Replace damaged material with new material.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

1.7 PROTECTION OF PROPERTY

Provide protection as indicated.

1.7.1 Flame-Heated Equipment

Locate and use flame-heated equipment so as not to endanger the structure or other materials on the site or adjacent property. Do not place flame-heated equipment on the roof. Provide and maintain a fire extinguisher near each item of flame-heated equipment.

1.7.2 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoist and kettles prior to starting the work. Lap protective coverings at least 6 inches, secure them against wind, and vent them to prevent collection of moisture on the covered surfaces. Keep protective coverings in place for the duration of the work with asphalt products.

1.7.3 Special Protection

Provide special protection approved by the insulation manufacturer, or avoid heavy traffic on completed work when ambient temperature is above 80 degrees F.

1.7.4 Drippage of Bitumen

Seal joints in and at edges of deck as necessary to prevent drippage of asphalt into building or down exterior walls.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Roof insulation shall be one or an assembly of a maximum of three of the following materials and compatible with attachment methods for the specified insulation and roof membrane:

a. Expanded Perlite Board: ASTM C 728. Minimum 3/4 inch thick when both top and bottom surfaces will be in contact with asphalt.
b. Polyisocyanurate Board: ASTM C 1289 Type I -- foil faced both sides or Type II, fibrous felt or glass mat membrane both sides, except minimum compressive strength shall be 20 pounds per square inch (psi).

c. Composite Boards: ASTM C 1289, Type III, perlite insulation board faced one side, fibrous felt or glass fiber mat membrane on other side. Type V, oriented strand board or waferboard on one side and fibrous felt or glass fiber mat membrane or aluminum foil on the other; ASTM C 1289 (Polyisocyanurate-perlite); or ASTM C 1050 (Polystyrene-wood fiberboard), Type III, Grade 1, Class A.

d. Cellular Glass Boards: ASTM C 552, Type IV.

e. Polystyrene Board: Shall be in accordance with ASTM C 578, Type II, IV, or X.

f. Wood Fiberboard: ASTM C 208, high density, except 4 by 4 feet maximum board size.

ASTM C 208 Type II, Grade 1 or 2, roof insulating board, treated with sizing, wax or bituminous impregnation. Bituminous impregnation shall be limited to 4 percent by weight when used over steel decks. Maximum board size: 4 feet by 4 feet.

2.1.2 Mineral-Fiber Insulation Board

ASTM C 726.

2.1.3 Recovered Materials

Provide thermal insulation materials containing recycled materials to the extent practical. The required minimum recycled material content for the listed materials are:

Perlite Composition Board:	23	percent postconsumer paper
Polyisocyanurate/polyurethane:	9	percent recovered material
Phenolic Rigid Foam:	5	percent recovered material
Wood Fiberboard		percent recovered material

2.1.4 Insulation Thickness

As necessary to provide a thermal resistance (R value) of _____ or more for average thickness of tapered system. Thickness shall be based on the "R" value for aged insulation. Insulation over steel decks shall satisfy both specified R value and minimum thickness for width of rib opening

recommended in insulation manufacturer's published literature.

2.1.5 Tapered Roof Insulation

One layer of the tapered roof insulation assembly shall be factory tapered to a slope of not less than 1/4, 1/2 inch per foot. Provide starter and filler blocks as required to provide the total thickness of insulation necessary to meet the specified slope and thermal conductance. Mitered joints shall be factory fabricated and shall consist of two diagonally cut boards or one board shaped to provide the required slopes. Identify each piece of tapered insulation board by color or other identity coding system, allowing the identification of different sizes of tapered insulation board required to complete the roof insulation system.

2.1.6 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation; or, when roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer, unless otherwise indicated. Face of cant strips shall have incline of 45 degrees and vertical height of 4 inches. Taper edge strips at a rate of one to 1 1/2 inch per foot down to approximately 1/8 inch thick.

2.2 PROTECTION BOARD

For use as a thermal barrier (underlayment), fire barrier (overlayment), or protection board for hot-mopped, torched-down, or adhesively-applied roofing membrane over roof insulation.

2.2.1 Glass Mat Gypsum Roof Board

ASTM C 1177/C 1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E 84, 500 psi, Class A, non-combustible, 1/4, 1/2, 5/8 inch thick, 4 by 8 feet board size.

2.3 BITUMENS

2.3.1 Asphalt Primer

ASTM D 41.

2.3.2 Asphalt

ASTM D 312, Type III or IV. Asphalt flash point, finished blowing temperature, and equiviscous temperature (EVT) for mop and for mechanical spreader application shall be indicated on bills of lading or on individual containers.

2.3.3 Asphalt Roof Cement

ASTM D 4586, Type I for horizontal surfaces and for surfaces sloped from 0 to 3 inches per foot, Type II for vertical and surfaces sloped more than 3 inches per foot.

2.4 SHEATHING PAPER FOR WOOD DECKS

Rosin-sized building paper or unsaturated felt weighing not less than 5 pounds per 100 square feet.

2.5 MOISTURE CONTROL

2.5.1 Vapor Retarder

2.5.1.1 Asphalt-Saturated Felt Base Sheet for Single Layer Application

ASTM D 4601, weighing not less than 35 pounds per 100 square feet.

2.5.1.2 Asphalt-Coated Glass Felt

ASTM D 2178, Type IV, VI.

2.5.2 Ventilating Felt for Poured, Precast Concrete Decks

ASTM D 4897, Type II, non-perforated, with spot mopping holes where specified.

2.5.3 Organic Roofing

ASTM D 226, Type I.

2.6 FASTENERS

Flush-driven through flat round or hexagonal steel or plastic plates. Steel plates shall be zinc-coated, flat round not less than 1 3/8 inch diameter or hexagonal not less than 28 gage. Plastic plates shall be high-density, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fastener head shall recess fully into the plastic plate after it is driven. Plates shall be formed to prevent dishing. Do not use bell-or cup-shaped plates. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than 40 pounds, 120 pounds each in steel deck. Fasteners for steel or concrete decks shall conform to FM P7825c for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 60, 90 pounds per square foot.

2.6.1 Roofing Nails for Wood Decks

Barbed 11 gage, zinc-coated nails with 7/16 to 5/8 inch diameter heads or annular ring shank, square head, one-piece composite nails. Nails shall be long enough to penetrate wood deck at least 5/8 inch but shall not protrude through underside of decking.

2.6.2 Fasteners for Plywood Decks

Annular ring shank, square head, one-piece composite nails long enough to penetrate into plywood decks approximately 1/2 inch but not protrude through underside of decking.

2.6.3 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws conforming to FM AS 4470 and listed in FM P7825c for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of 60, 90 psf conforming to FM P7825.

2.6.4 Fasteners for Poured Concrete Decks

Approved hardened fasteners or screws to penetrate deck at least one inch but not more than 1 1/2 inches, conforming to FM AS 4470, and listed in FM P7825 for Class I roof deck construction. Quantity and placement to withstand an uplift pressure of 60, 90 psf conforming to FM P7825.

2.7 WOOD NAILERS

Pressure-preservative-treated as specified in Section 06 10 00 ROUGH CARPENTRY.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Surfaces shall be clean, smooth, and dry. Surfaces receiving vapor retarder shall be free of projections which might puncture the vapor retarder. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contractor shall, Contracting Officer will inspect and approve the surfaces immediately before starting installation. Prior to installing vapor retarder, ventilating felt, insulation, perform the following:

a. Examine wood decks to ascertain that deck boards have been properly nailed and that exposed nail heads have been set.

b. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

c. Examine precast concrete decks to ensure that joints between precast units are properly grouted and leveled to provide suitable surfaces for installation of ventilating felt, vapor retarder and insulation.

d. In the presence of the Contracting Officer perform the following surface-dryness test on concrete substrates:

(1) Foaming: When poured on the deck, one pint of asphalt when heated in the range of 350 to 400 degrees F, shall not foam upon contact.

(2) Strippability: After asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from surface, do not consider surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been tested by method above and found dry.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage and hollow or low spots and perform the following:

a. Install wood nailers the same thickness as insulation at eaves, edges, curbs, walls, and roof openings for securing cant strips, gravel stops, gutters, and flashing flanges. On decks with slopes of one inch per foot or more, install wood nailers perpendicular to slope for securing insulation and for backnailing of roofing felts. Space nailers in accordance with approved shop drawings.

b. Fill or cover cracks or knot holes larger than 1/2 inch in diameter in wood decks as necessary to form an unyielding surface.

. Cover wood decks with a layer of rosin-sized building paper or unsaturated felt. Lap sides and ends not less than 3 inches. Nail sufficiently to prevent tearing or buckling during installation.

d. Cover steel decks with a layer of insulation board of sufficient thickness to span the width of a deck rib opening, and conforming to fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement conforming to FM P7825. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs.

e. Solidly apply asphalt primer to poured, precast concrete decks at the rate of one gallon per 100 square feet of roof surface, stopping approximately 4 inches from joints between the precast concrete units. Allow primer to dry thoroughly. Place felt strips, 4 inches or more in width, over joints, 2 inches on each side, between precast concrete units in a heavy coating of cold-applied asphalt roof cement.

3.2 INSTALLATION OF VAPOR RETARDER

Install vapor retarder in direct contact with roof deck surface, ventilating felt, insulation. Vapor retarder shall consist of either two plies of No. 15 asphalt-saturated felt, two plies of asphalt-coated glass felt, or one layer of asphalt-saturated felt base sheet. Lay vapor retarder at right angles to direction of slope. Install first ply of felt or base sheet as specified herein for the specific deck. Apply second ply of 2-ply vapor retarder system using asphalt at rate of 20 to 35 lbs per 100 square feet, applied within plus or minus 25 degrees F of EVT. Do not heat asphalt above asphalt's FBT or 525 degrees F, whichever is less. Use thermometers to check temperatures during heating and application. Side and end laps shall be completely sealed. Asphalt shall be visible beyond all edges of each ply as it is being installed. Plies shall be laid free of wrinkles, buckles, creases or fishmouths. Workers shall not walk on mopped surfaces when the asphalt is sticky. Press out air bubbles to obtain complete adhesion between surfaces. At walls, eaves and rakes, and other vertical surfaces, the vapor retarder organic felts shall be extended 9 inches, or separate organic felt plies shall be extended 9 inches, with not less than 9 inches on the substrate, and the extended portion turned back and mopped in over the top of the insulation. At roof penetrations other than walls, eaves and rakes, and vertical surfaces, the vapor retarder or separate plies shall be extended 9 inches to form a lap which shall later be folded back over the edge of the insulation. Asphalt roof cement shall be used under the vapor retarder for at least 9 inches from walls, eaves, rakes and other penetrations.

3.2.1 Vapor Retarder on Poured Concrete Decks

Solidly mop primed substrate with asphalt at rate of 20 to 35 lbs per 100 square feet before installing vapor retarder. Lay first ply of 2 ply system with each sheet lapping 19 inches over the preceding sheet. Lap ends not less than 4 inches. Stagger laps a minimum of 12 inches. For a vapor retarder consisting of one layer of asphalt base sheet, provide side and end laps not less than 4 inches. Stagger laps a minimum of 12 inches. Cement base sheets together with a solid mopping of asphalt.

3.2.2 Vapor Retarder on Precast Concrete Decks

Solidly mop primed substrate with asphalt at rate of 20 to 35 lbs per 100 square feet before installing vapor retarder. Lay first ply of 2 ply system with each sheet lapping 19 inches over preceding sheet. Lap ends not less than 4 inches. Stagger laps a minimum of 12 inches. For vapor retarder consisting of one layer of asphalt base sheet, provide side and end laps not less than 4 inches and stagger laps a minimum of 12 inches. Cement base sheets together with a solid mopping of asphalt.

3.2.3 Vapor Retarder on Wood Decks

Lay first ply of 2 ply system dry with each sheet lapping 2 inches over the preceding sheet. Lap ends not less than 4 inches. Stagger laps a minimum of 12 inches. Nail felt at 6 inch intervals along side laps and install two rows of nails approximately 11 inches apart down longitudinal center of each sheet, with nails staggered at 18 inches O.C. For vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inches over the preceding sheet. Provide end laps not less than 4 inches and stagger laps a minimum of 12 inches. Cement side and end laps together with solid mopping of asphalt or heavy coat of asphalt roof cement. Nail side laps at 6 inch intervals. Apply asphalt mopping at rate of 20 to 35 lbs per 100 square feet. Install two rows of nails approximately 11 inches apart down longitudinal center of each sheet, with nails staggered at 18 inches O.C.

3.2.4 Vapor Retarder on Steel Decks

Solidly mop the mechanically secured insulation surface with asphalt before installing vapor retarder. For a 2 ply vapor retarder, install each sheet lapping 19 inches over the preceding sheet. Lap ends not less than 4 inches. Stagger the laps a minimum of 12 inches. Cement felts together with solid mopping of asphalt. Apply asphalt moppings at rate of 20 to 35 lbs per 100 square feet. For a vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inchesover preceding sheet. Lap ends not less than 4 inches, and stagger laps a minimum of 12 inches. Cement base sheets together with solid mopping of asphalt.

3.2.5 Over Gypsum Insulating Concrete or Lightweight Insulating Concrete

One ply of venting inorganic base sheet shall be laid, without mopping, at right angle to the slope with 4 inch side laps and 6 inch end laps. Laps shall be bonded with hot asphalt. End laps shall be staggered. Base sheet shall be nailed 9 inches on centers at side laps and in 2 rows 11 inches apart down the center of the sheet with nails 18 inches on centers and staggered, attached to the concrete as determined by uplift requirements. The 2-ply vapor retarder shall then be applied over the base sheet as specified above.

3.2.6 Over Concrete Decks and First Layer of Insulation on Steel Decks

The 2-ply vapor retarder shall be applied as specified above except that venting inorganic base sheet shall be deleted.

3.2.7 Over Structural Concrete on Non-Venting Support

One ply of venting inorganic base sheet with mopping holes shall be laid dry at right angle to the slope with 4 inch side laps and 6 inch end laps. The vapor retarder shall then be applied as specified.

3.3 INSTALLATION OF VENTILATING FELT

Apply ventilating felt in accordance with manufacturer's printed instructions, spot-mopped with asphalt to concrete deck. Extend over roof cants, up vertical surfaces and terminate under cap flashing; at roof edges terminate under outside edge of perimeter edge nailers or under gravel stop fascia.

3.4 INSULATION INSTALLATION

Apply insulation in two layers with staggered joints when total required thickness of insulation exceeds 1/2 inch. Lay insulation so that continuous longitudinal joints are perpendicular to direction of felts for the built-up roofing, as specified, and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and offset in both directions with respect to layer below. Keep insulation 1/2 inch clear of vertical surfaces penetrating and projecting from roof surface.

3.4.1 Installation Using Asphalt

Firmly embed each layer in solid asphalt mopping; mop only sufficient area to provide complete embedment of one board at a time. Provide 20 to 35 lbs of asphalt per 100 square feet of roof deck for each layer of insulation. Apply asphalt when temperature is within plus or minus 25 degrees F of EVT. Do not heat asphalt above asphalt's FBT or 525 degrees F, whichever is less, for longer than 4 consecutive hours. Use thermometers to check temperatures during heating and application.

3.4.2 Installation Using Asphalt on Steel Decks

Secure first layer of insulation and thermal barrier to deck with piercing or self-drilling, self-tapping fasteners. Engage fasteners by driving them through insulation into top flange of steel deck. Use driving method prescribed by fastener manufacturer. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs. Secure succeeding layers with solid asphalt moppings. Where insulation is applied over steel deck, long edge joints shall continuously bear on surfaces of the steel deck. Insulation which can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is waterproofed the same day. Phased construction will not be permitted. Application of impermeable faced insulation shall be performed without damage to the facing.

3.4.3 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation with penetrating type fasteners.

3.4.4 Special Precautions for Installation of Foam Insulation

3.4.4.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 1/2 inch thick wood fiberboard, glass mat gypsum roof board, or 3/4 inch thick expanded perlite board insulation over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

3.4.4.2 Polystyrene Insulation

a. Over top surface of non-composite polystyrene board, install 1/2 inch thick high density wood fiberboard, 3/4 inch thick expanded perlite board, glass mat gypsum roof board, or other overlayment approved by roofing sheet manufacturer. Tightly butt and stagger joints of field applied overlayment board at least 6 inches with respect to the polystyrene board below. Apply 6 inch wide glass fiber roofing tape centered over joints and edges of overlayment board.

b. Where composite boards consisting of polystyrene insulation are provided, apply 6 inch wide glass-fiber roofing tape centered over joints and edges of composite board. Apply joint strips as recommended by roofing sheet manufacturer.

3.4.5 Cant Strips

Where indicated, provide cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Wood cant strips shall bear on and be anchored to wood blocking. Fit cant strips flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in heavy mopping of asphalt or set in a heavy coating of asphalt roof cement, an approved adhesive.

3.4.6 Tapered Edge Strips

Where indicated, provide edge strips in the right angle formed by junction of roof and wood nailing strips that extend above level of roof. Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in heavy mopping of asphalt or set in heavy coating of asphalt roof cement, an approved adhesive.

3.5 PROTECTION

3.5.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with the finished roofing specified, on same day. Do not permit phased construction. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to indicated live load limits of roof construction, a _____ psf live load limit. Exposed edges of the

insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement or single ply or EPDM membrane set in roof cement. Fill all profile voids in cut-offs to prevent entrapping of moisture into the area below the membrane. Cutoffs shall be removed when work is resumed.

3.5.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.6 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

b. Verification of certification, listing or label compliance with FM P9513.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.

e. Inspection of mechanical fasteners; type, number, length, and spacing.

f. Coordination with other materials, cants, sleepers, and nailing strips.

g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

h. Installation of cutoffs and proper joining of work on subsequent days.

i. Continuation of complete roofing system installation to cover insulation installed same day.

-- End of Section --

SECTION 07 24 00

EXTERIOR INSULATION AND FINISH SYSTEMS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(2007) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 67	(2007a) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 847	(2006) Standard Specification for Metal Lath
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 3273	(2000; R 2005) Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM D 968	(2005e1) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 2098	(2000; R 2006) Determining Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for Use in Class PB Exterior Insulation and Finish Systems (EIFS) after Exposure to a Sodium Hydroxide Solution
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 331	(2000) Water Penetration of Exterior

	Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 695	(2003) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G 153	(2004) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

EIFS INDUSTRY MEMBERS ASSOCIATION (EIMA)

EIMA TM 101.01	(1995) Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS), Class PB
EIMA TM 101.86	(1995) Resistance of Exterior Insulation Finish Systems (EIFS), Class PB to The Effects of Rapid Deformation (Impact)

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

UBC 26-4	Evaluation of Flammability Characteristics of Exterior, Non load-Bearing Wall Panel Assemblies using Foam Plastic Insulation
UBC 26-9	Evaluation of Flammability Characteristics of Exterior Non load-Bearing Wall Assemblies Containing Combustible Components using Intermediate-Scale, Multistory Test Apparatus Title

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 268	(2006) Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source

1.2 SYSTEM DESCRIPTION AND REQUIREMENTS

The exterior insulation and finish system (EIFS) shall be a job-fabricated exterior wall covering consisting of sheathing, insulation board, reinforcing fabric, base coat, finish coat, adhesive and mechanical fasteners as applicable. The system components shall be compatible with each other and with the substrate as recommended or approved by, and the products of, a single manufacturer regularly engaged in furnishing Exterior Insulation and Finish Systems. All materials shall be installed by an applicator approved by the system manufacturer. EIFS shall be Class PB or Class PM, as indicated and shall be as indicated.

1.2.1 System Requirements and Tests

The system shall meet the performance requirements as verified by the tests

listed below. Where a wall system of similar type, size, and design as specified for this project has been previously tested under the condition specified herein, the resulting test reports may be submitted in lieu of job specific tests.

1.2.1.1 Water Penetration

Test the system for water penetration by uniform static air pressure in accordance with ASTM E 331. There shall be no penetration of water beyond the plane of the base coat/EPS board interface after 15 minutes at 6.4 psf), or 20% of positive design wind pressure, whichever is greater.

1.2.1.2 Wind Load

Test the system for wind load by uniform static air pressure in accordance with ASTM E 330 (procedure A) to a minimum pressure of 130 mph. There shall be no permanent deformation, delamination, or other deterioration.

1.2.1.3 Full scale or intermediate scale fire test

Conduct wall fire test using apparatus, specimen, performance criteria, and procedure in accordance with UBC 26-4. The specimen shall include the complete system using 102mm (4 inch) thick insulation board. At the option of the contractor, UBC 26-9, Intermediate-Scale Test may be substituted in lieu of the Full-Scale Multi- Story Fire test. The following requirements shall be met:

a. No vertical spread of flame within core of panel from one story to the next.

b. No flame spread over the exterior surface.

c. No vertical flame spread over the interior surface from one story to the next.

d. No significant lateral spread of flame from compartment of fire origin to adjacent spaces.

1.2.1.4 Mock-Up Installation of EIFS

Complete wall mock-up installation 4 ft high by 4 ft wide, including typical control joints and at least one window opening. Control joints to be filled with sealant of type, manufacturer, and color selected. Construct mock-up installation at manufacturer's plant, job site. Build mock-up to comply with the following requirements, using materials indicated for the completed work:

a. Locate mock-up installation(s)in the location and size indicated, as directed by the Contracting officer.

b. Demonstrate the proposed range of color, texture, thickness, insulation, and workmanship.

c. Obtain Contracting Officer's written approval of mock-up before starting fabrication of work.

d. Maintain mock-up installation(s) during construction as a standard for judging the completed work by protecting them from weather and construction activities.

e. When directed, demolish and remove mock-up from the site.

1.2.2 Component Requirements and Tests

The components of the system shall meet the performance requirements as veryfied by the tests listed below.

1.2.2.1 Surface Burning Characteristics

Conduct ASTM E 84 test on samples consisting of base coat, reinforcing fabric, and finish coat. Cure for 28 days. The flame spread index shall be 25 or less and the smoke developed index shall be 450 or less.

1.2.2.2 Radiant Heat

The system shall be tested in accordance with NFPA 268 on both the minimum and maximum thickness of insulation intended for use with no ignition during the 20-minute period.

1.2.2.3 Impact Resistance

a. Class PB Systems: Hemispherical Head Test; 28 day cured specimen of PB EIFS in accordance with EIMA TM 101.86. The test specimen shall exhibit no broken reinforcing fabric per EIMA TM 101.86 at an impact of 30 lbs.

b. Impact Mass: Test 28 day cured specimen of PM EIFS in accordance with ASTM E 695. The test specimen shall exhibit no cracking or denting after twelve impacts by (30 lbs) lead shot mass from (6 in to 6 ft) drop heights in (6 in) intervals.

1.2.3 Sub-Component Requirements and Tests

Unless otherwise stated, the test specimen shall consist of reinforcing mesh, base coat, and finish coat applied in accordance with manufacturer's printed recommendations to the insulation board to be used on the building. For mildew resistance, only the finish coat is applied onto glass slides for testing. These specimen shall be suitably sized for the apparatus used and be allowed to cure for a minimum of 28 days prior to testing.

1.2.3.1 Abrasion Resistance

Test in accordance with ASTM D 968, Method A. Test a minimum of two specimens. After testing, the specimens shall show only very slight smoothing, with no loss of film integrity after (132 gallons) of sand.

1.2.3.2 Accelerated Weathering

Test in accordance with ASTM G 153, Cycle 1. After 2000 hours specimens shall exhibit no visible cracking, flaking, peeling, blistering, yellowing, fading, or other such deterioration.

1.2.3.3 Mildew Resistance

Test in accordance with ASTM D 3273. The specimen shall consist of the finish coat material, applied to clean (3 inch by 4 inch) glass slides and

shall be allowed to cure for 28 days. After 28 days of exposure, the specimen shall not show any growth.

1.2.3.4 Salt Spray Resistance

Test in accordance with ASTM B 117. The specimen shall be a minimum of (4 inch by 6 inch) and shall be tested for a minimum of 300 hours. After exposure, the specimen shall exhibit no observable deterioration, such as chalking, fading , or rust staining.

1.2.3.5 Water Resistance

Test in accordance with ASTM D 2247. The specimen shall be a minimum of (4 inch by 6 inch). After 14 days, the specimen shall exhibit no cracking, checking, crazing, erosion, blistering, peeling, or delamination.

1.2.3.6 Absorption-Freeze/Thaw

Class PB systems shall be tested in accordance with EIMA TM 101.01 for 60 cycles of freezing and thawing. No cracking, checking, or splitting, and neglible weight gain. Class PM systems shall be tested in accordance with ASTM C 67 for 50 cycles of freezing and thawing. After testing, the specimens shall exhibit no cracking or checking and have negligible weight gain.

1.2.3.7 Sample Boards

Unless otherwise stated, provide sample EIFS Component 12 by 24 inches), on sheathing board, including finish color and texture, typical joints and sealant. If more than one color, finish, or pattern is used, provide one sample for each. The test specimen shall consist of reinforcing mesh, base coat, and finish coat applied in accordance with manufacturer's printed recommendations to the insulation board to be used on the building.

1.2.4 Moisture Analysis

Perform a job specific vapor transmission analysis based on project specific climate and specified wall components and materials. Indicate the temperatures and relative humidities for the inside and outside of the building; a complete listing of the building components, their thickness, thermal resistance and permeance, as well as building location and use. If a mathematical model was used for the analysis, include the name of the model and the supplier/developer.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop drawings

Show wall layout, construction and expansion joints, decorative grooves, layout of sheathing board, thermal insulation board, and reinforcing mesh and strip reinforcing fabric; joint and flashing details; details at wall penetrations; types and location of fasteners; details at windows and or doors; and details at base, roof, parapet, corners.

SD-03 Product Data

Sheathing board

Thermal insulation

Adhesive

Mechanical Fasteners

Accessories

Base coat

Portland cement

Reinforcing fabric

Finish coat

Joint Sealant

Sealant Primer

Bond breaker

Backer Rod

Insulation Board

Warranty

Include joint and other details, such as end conditions, corners, windows, and parapet. Include shelf life and recommended cleaning solvents in data for sealants. Include material safety data sheets (MSDS)for all components of the EIFS. The MSDS shall be available at the job site.

SD-04 Samples

Sample Boards
Color and Texture

Mock-up Installation of EIFS

SD-05 Design Data

Wind load Calculations

Moisture analysis Calculations

SD-06 Test Reports

Abrasion resistance

Accelerated weathering

Impact resistance

Mildew resistance

Salt spray resistance

Water vapor transmission

Absorption-freeze-thaw

wall fire test

Water penetration

Water resistance

Full scale or intermediate scale fire test

Surface Burning Characteristics

Radiant heat

substrate

Wind load

SD-07 Certificates

Qualifications of EIFS Manufacturer

Qualification of EIFS Installer

Qualification of Sealant Applicator

Certify that EIFS installer meets requirements specified under paragraph "Qualification of Installer," and that sealant applicator is approved by the EIFS Manufacturer.

Qualifications of Third Party Inspector

Inspection Check List

Submit filled-out inspection check list as required in paragraph "Quality Control," certifying that the installation of critical items meets the requirements of this specification.

SD-08 Manufacturer's Instructions

Installation

Manufacturer's standard printed instructions for the installation of the EIFS. Include requirements for condition and preparation of substrate, installation of EIFS, and requirements for sealants and sealing.

SD-10 Operation and Maintenance Data

EIFS

Include detailed finish repair procedures and information

regarding compatibility of sealants with base and finish coatings.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of EIFS Manufacturer

The EIFS shall be the product of a manufacturer who has been in the practice of manufacturing and designing EIFS for a period of not less than 3 years, and has been involved in at least five projects similar to this project in size, scope, and complexity, in the same or a similar climate as this project.

1.4.2 Qualification of EIFS Installer

The EIFS Installer shall be trained by the EIFS manufacturer to perform the installation of the System and shall have successfully installed at least five projects at or near the size and complexity of this project. The contractor shall employ qualified workers trained and experienced in installing the manufacturer's EIFS.

1.4.3 Qualification of Sealant Applicator

The sealant applicator shall be experienced and competent in the installation of high performance industrial and commercial sealants and shall have successfully installed at least five projects at or near the size and complexity of this project.

1.4.4 Qualifications of Third Party Inspector

Submit evidence that third party inspector has current certification from the Exterior Design Institute or equal inspector certification as inspector for the installation of EIFS.

1.4.5 Insulation Board-

Insulation Board shall be approved and labeled under third party quality program as required by applicable building code.

1.4.6 Pre-Installation Conference

After approval of submittals and before commencing any work on the EIFS , including installation of any sheathing board, insulation, and associated work, the Contracting Officer will hold a pre-installation conference to review:

a. Drawings, specifications, and samples;

b. Procedure for on site inspection and acceptance of EIFS substrate and pertinent details (for example, mock-up installation);

c. Contractor's plan for coordination of work of the various trades involved in providing EIF system and other components;

d. Inspection procedures; and

e. Safety requirements.

Pre-installation conference shall be attended by the Contractor, EIFS Q.C. Specialist (EIFS Inspector), and all personnel directly responsible

for installation of the EIF system, including sealant applicator, and personnel responsible for related work, such as flashing and sheet metal, windows and doors, and a representative of the EIFS manufacturer. Before beginning EIFS work, the contractor shall confirm in writing the resolution of conflicts among those attending the pre-installation conference.

1.5 DELIVERY AND STORAGE

Deliver materials to job site in original unopened packages, marked with manufacturer's name, brand name, and description of contents. Store materials off the ground and in accordance with the manufacturer's recommendations in a clean, dry, well-ventilated area. Protect stored materials from rain, sunlight, and excessive heat. Keep coating materials which would be damaged by freezing at a temperature not less than 40 degrees F. Do not expose insulation board to flame or other ignition sources.

1.6 ENVIRONMENTAL CONDITIONS

a. Do not prepare materials or apply EIFS during inclement weather unless appropriate protection is provided. Protect installed materials from inclement weather until they are dry.

b. Apply sealants and wet materials only at ambient temperatures of 40 degrees F or above and rising, unless supplemental heat is provided. The system shall be protected from inclement weather and to maintain this temperature for a minimum of 24 hours after installation.

c. Do not leave insulation board exposed to sunlight after installation.

1.7 WARRANTY

Furnish manufacturer's standard warranty for the EIFS. Warranty shall run directly to Government and cover a period of not less than 5 years from date Government accepted the work.

PART 2 PRODUCTS

2.1 COMPATIBILITY

Provide all materials compatible with each other and with the substrate, and as recommended by EIFS manufacturer.

2.2 SHEATHING BOARD

2.3 ADHESIVE

Manufacturer's standard product, including primer as required, and shall be compatible with substrate and insulation board to which the system is applied.

2.4 LATHING AND FURRING

Conform to ASTM C 847, (2.5 lb/sqyd), self-furring, galvanized.

2.5 MECHANICAL FASTENERS

Corrosion resistant and as approved by EIFS manufacturer. Select fastener type and pattern based on applicable wind loads and substrate into which fastener will be attached, to provide the necessary pull-out, tensile, and shear strengths.

2.6 THERMAL INSULATION

2.6.1 Manufacturer's Recommendations

Provide only thermal insulation recommended by the EIFS manufacturer for the type of application intended.

2.6.2 Insulation Board

Insulation board shall be standard product of manufacturer and shall be compatible with other systems components. Boards shall be factory marked individually with the manufacturer's name or trade mark, the material specification number, the R-value at 75 degree F, and thickness. No layer of insulation shall be less than (3/4 in) thick. The maximum thickness of all layers shall not exceed 4 in. Insulation Board shall be certified as aged, in block form, prior to cutting and shipping, a minimum of 6 weeks by air drying, or equivalent.

a. Thermal resistance: As indicated

b. Insulating material: ASTM C 578 Type I as recommended by the EIFS manufacturer and treated to be compatible with other EIFS components. Age insulation by air drying a minimum of 6 weeks prior to cutting and shipping.

2.7 BASE COAT

Manufacturer's standard product and compatible with other systems components.

2.8 PORTLAND CEMENT

Conform to ASTM C 150, Type I or II as required, fresh and free of lumps, and approved by the systems manufacturer.

2.9 REINFORCING FABRIC

Reinforcing fabric mesh shall be alkali-resistant, balanced, open weave , glass fiber fabric made from twisted multi-end strands specifically treated for compatibility with the other system materials, and comply with ASTM E 2098 and as recommended by EIFS manufacturer.

2.10 FINISH COAT

Manufacturer's standard product conforming to the requirements in the paragraph on Sub-Component Requirements and Tests. For color consistency, use materials from the same batch or lot number.

2.11 SEALANT PRIMER

Non-staining, quick-drying type recommended by sealant manufacturer and EIFS manufacturer.

2.12 ACCESSORIES

Conform to recommendations of EIFS manufacturer, including trim, edging, anchors, expansion joints. All metal items and fasteners to be corrosion resistant.

2.13 JOINT SEALANT

Non-staining, quick-drying type meeting ASTM C 920, as Type S or M, minimum Grade NS, minimum Class 25 and compatible with the finish system type and grade, and recommended by both the sealant manufacturer and EIFS manufacturer.

2.14 BOND BREAKER

As required by EIFS manufacturer and recommended by sealant manufacturer and EIFS manufacturer.

2.15 BACKER ROD

Closed cell polyethylene free from oil or other staining elements and as recommended by sealant manufacturer and EIFS manufacturer. Do not use absorptive materials as backer rod. The backer rod should be sized 25 percent larger than the width of the joint.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrate and existing conditions to determine that the EIFS can be installed as required by the EIFS manufacturer and that all work related to the EIFS is properly coordinated. Surface shall be sound and free of oil, loose materials or protrusions which will interfere with the system installation. If deficiencies are found, notify the Contracting Officer and do not proceed with installation until the deficiencies are corrected. The substrate shall be plane, with no deviation greater than (1/4 inch) when tested with a (10 foot) straightedge. Determine flatness, plumbness, and any other conditions for conformance to manufacturer's instructions.

3.2 SURFACE PREPARATION

Prepare existing surfaces for application of the EIFS to meet flatness tolerances and surface preparation according to manufacturer's installation instructions but provide a flatness of not more that 1/4 inch in 10 feet. Provide clean surfaces free of oil and loose material without protrusions adversely affecting the installation of the insulation board. For adhesively attached EIFS, existing deteriorated paint must be removed. Due to substrate conditions or as recommended by the system manufacturer, a primer may be required. Apply the primer to existing surfaces as recommended by the manufacturer. Use masking tape to protect areas adjacent to the EIFS to prevent base or finish coat to be applied to areas not intended to be covered with the EIFS. The contractor shall not proceed with the installation until all noted deficiencies of the substrate are corrected.

3.3 INSTALLATION

Install EIFS as indicated, comply with manufacturer's instructions except

as otherwise specified, and in accordance with the shop drawings. EIFS shall be installed only by an applicator trained by the EIFS manufacturer. Specifically, include all manufacturer recommended provisions regarding flashing and treatment of wall penetrations.

3.3.1 Sheathing Board

Edges and ends of boards shall be butted snugly with vertical joints staggered to provide full and even support for the insulation. Do not align sheathing board joints with wall openings. Provide support at both vertical and horizontal joints. Attach sheathing board to metal studs with self-tapping drywall screws, to concrete or masonry with corrosion resistant metal fasteners. Place fasteners sufficiently close to support imposed loads, but not more than:

a. Maximum of (8 inches) apart on each supporting stud

b. Maximum of (12 inches) apart horizontally and vertically into concrete, masonry.

Space fasteners more closely when required for negative wind load resistance.

3.3.2 Insulation Board

Unless otherwise specified by the system manufacturer, place the long edge horizontally from level base line. Stagger vertical joints and interlock at corners. Butt joints tightly. Provide flush surfaces at joints. Offset insulation board joints from joints in sheathing by at least (8 inches). Use L-shaped insulation board pieces at corners of openings. Joints of insulation shall be butted tightly. Surfaces of adjacent insulation boards shall be flush at joints. Gaps greater than (1/16 inch) between the insulation boards shall be filled with slivers of insulation. Uneven board surfaces with irregularities projecting more than (1/16 inch) shall be rasped in accordance with the manufacturer's instructions to produce an even surface. Attach insulation board as recommended by manufacturer. The adhered insulation board shall be allowed to remain undisturbed for 24 hours prior to proceeding with the installation of the base coat/reinforcing mesh, or longer if necessary for the adhesive to dry. However, do not leave insulation board exposed longer than recommended by insulation manufacturer.

3.3.2.1 Mechanically Fastened Insulation Boards

Fasten with manufacturer's standard corrosion resistant anchors, spaced as recommended by manufacturer, but not more than (2 feet) horizontally and vertically.

3.3.2.2 Adhesively Fastened Insulation Boards

Apply insulation board using adhesive spread with a notched trowel to the back of the insulation boards in accordance with the manufacturer’s instructions.

3.3.3 Base Coat and Reinforcing Fabric Mesh,

3.3.3.1 Class PB Systems

Allow the adhered insulation board to dry for 24 hours, or longer if

necessary, prior to proceeding with the installation of the base coat/reinforcing fabric mesh Install reinforcing fabric in accordance with manufacturer's instructions. Mix base coat in accordance with the manufacturer's instructions and apply to insulated wall surfaces to the thickness specified by the system manufacturer and provide any other reinforcement recommended by EIFS manufacturer. Trowel the reinforcing fabric mesh into the wet base coat material. Fully embed the mesh in the base coat. When properly worked-in, the pattern of the reinforcing fabric mesh shall not be visible. Provide diagonal reinforcement at opening corners. Back-wrap or edge wrap all terminations of the EIFS. Overlap the reinforcing fabric mesh a minimum of 2.5 inches on previously installed mesh, or butted, in accordance with the manufacturer's instructions.

3.3.3.2 Class PM Systems

Mechanically fasten reinforcing fabric mesh to the insulated wall using the type and spacing of fasteners specified in the manufacturer's instructions. Provide diagonal reinforcement at opening corners. Mix base coat in accordance with manufacturer's instructions. Apply base coat in accordance with manufacturer's instruction to provide a complete, tight coating of uniform thickness as specified by the manufacturer. Cover all fiberglass reinforcing fabric, including at back wrapped areas at panel joints and at fasteners.

3.3.4 Finish Coat

The base coat/reinforcing mesh must be allowed to dry a minimum of 24 hours prior to application of the finish coat. Surface irregularities in the base coat, such as trowel marks, board lines, reinforcing mesh laps, etc., shall be corrected prior to the application of the finish coat. Apply and level finish coat in one operation. Obtain final texture by trowels, floats, or by spray application as necessary to achieve the required finish matching approved sample, mock-up installation. Apply the finish coat to the dry base coat maintaining a wet edge at all times to obtain a uniform appearance. The thickness of the finish coat shall be in accordance with the system manufacturer's current published instructions. Apply finish coat so that it does not cover surfaces to which joint sealants are to be applied.

3.4 JOINT SEALING

Seal EIFS at openings as recommended by the system manufacturer. Apply sealant only to the base coat or base coat with EIFS Manufacturer's color coating. Do not apply sealant to the finish coat.

3.4.1 Surface Preparation, Backer Rod, and Primer

Immediately prior to application, remove loose matter from joint. Ensure that joint is dry and free of finish coat, or other foreign matter. Install backer rod. Apply primer as required by sealant and EIFS manufacturer. Check that joint width is as shown on drawings but in no case shall it be less than 0.5 inch for perimeter seals and 0.75 inch for expansion joints. The width shall not be less than 4 times the anticipated movement. Check sealant manufacturer's recommendations regarding proper width to depth ratio.

3.4.2 Sealant

Do not apply sealant until all EIFS coatings are fully dry. Apply sealant

in accordance with sealant manufacturer's instructions with gun having nozzle that fits joint width. Do not use sealant that has exceeded shelf life or can not be discharged in a continuous flow. Completely fill the joint solidly with sealant without air pockets so that full contact is made with both sides of the joint. Tool sealant with a round instrument that provides a concave profile and a uniformly smooth and wrinkle free sealant surface. Do not wet tool the joint with soap, water, or any other liquid tooling aid. During inclement weather, protect the joints until sealant application. Use particular caution in sealing joints between window and door frames and the EIFS wall and at all other wall penetrations. Clean all surfaces to remove excess sealant.

3.5 FIELD QUALITY CONTROL

Throughout the installation, the contractor shall establish and maintain an inspection procedure to assure compliance of the installed EIFS with contract requirements. Work not in compliance shall be removed and replaced or corrected in an approved manner. The inspection procedures, from acceptance of deliveries through installation of sealants and final acceptance shall be performed by qualified inspector trained by the manufacturer. No work on the EIFS shall be performed unless the inspector is present at the job site.

3.5.1 Third Party Inspection

Provide full time third party inspection during the entire process of installing the EIFS, from examination through cleanup. The third party inspector shall be certified by the Exterior Design Institute (EDI), AWCI, or by an equivalent independent party and shall be trained in the proper installation of EIFS.

3.5.2 Inspection Check List

During the installation and at the completion of installation, perform inspections covering at the minimum all applicable items enumerated on the attached check list. The inspector shall initial and date all applicable items, sign the check list, and submit it to the Contracting Officer at the completion of the EIFS erection.

CHECK LIST

Item	Description	Appr'd/Date
a.	Materials are handled and stored correctly.	_____
b.	Environmental conditions are within specified limits, including temperature not below 4 degrees C (40 degrees F), and the work is protected from the elements as required.	_____
c.	Preparation and installation is performed by qualified personnel using the correct tools.	_____
d.	Adjacent areas to which EIFS is not to be applied (such as on window and door frames) are protected with masking tape, plastic films, drop cloths, etc. to prevent accidental application of EIFS materials.	_____
e.	Control, expansion and aesthetic joints are installed as	_____

CHECK LIST

Item	Description	Appr'd/Date
	indicated or recommended. Accessories are properly installed.	
f.	Substrate is in-plane, properly attached, clean, dry, and free of contaminants. Concrete substrate is free of efflorescence.	_____
g.	Materials are mixed thoroughly and in proper proportions.	_____
h.	Adhesive is applied in sufficient quantity with proper-size notched trowel.	_____
i.	Mechanical attachments have proper spacing, layout and fastener depth.	_____
j.	Insulation boards are tightly abutted, in running bond pattern, with joints staggered with the sheathing, board corners interlocked, L-shaped boards around openings, edges free of adhesive, and provision for joints. Gaps are filled and surfaces rasped.	_____
k.	Insulation adhesive must be allowed to dry (a minimum of 24-hours) prior to the application of the base coat.	_____
l.	Reinforcing fabric mesh is properly back-wrapped at terminations.	_____
m.	Reinforcing fabric mesh is fully embedded and properly placed. Corners are reinforced. Openings are diagonally reinforced. Mesh overlaps minimum 65 mm (2-1/2 inches).	_____
n.	Base coat thickness is within specified limits.	_____
o.	The base coat/reinforcing fabric mesh must be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat.	_____
p.	Finish coat is applied with sufficient number of personnel and stopped at suitable points. Floats and methods of texturing are uniform.	_____
q.	All Flashings are properly installed.	_____
r.	All joints are properly sealed in their entire length at time and under environmental conditions as specified by the manufacturer.	_____
s.	All scaffolding, equipment, materials, debris and temporary protection are removed from site upon completion.	_____

Name of Inspector:_____ Signed:_____ Date:_____

3.6 CLEANUP

Upon completion, remove all scaffolding, equipment, materials and debris from site. Remove all temporary protection installed to facilitate installation of EIFS.

-- End of Section --

SECTION 07 31 13

ASPHALT SHINGLES

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1970	(2001) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 3018	(2003) Class A Asphalt Shingles Surfaced With Mineral Granules
ASTM D 3462	(2007) Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules
ASTM D 41	(2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4586	(2007) Asphalt Roof Cement, Asbestos-Free
ASTM D 4869	(2005; R 2006) Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing
ASTM D 6380	(2003) Standard Specification for Asphalt Roll Roofing (Organic Felt)

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0408	(Fifth Edition) Steep-slope Roofing Manual

UNDERWRITERS LABORATORIES (UL)

UL 790	(2004) Test Methods for Fire Tests of Roof Coverings
UL 997	(1995; Rev Jul 1998) Wind Resistance of Prepared Roof Covering Materials

1.2 DEFINITIONS

1.2.1 Top Lap

That portion of shingle overlapping shingle in course below.

1.2.2 Head Lap

The triple coverage portion of top lap which is the shortest distance from the butt edge of an overlapping shingle to the upper edge of a shingle in the second course below.

1.2.3 Exposure

That portion of a shingle exposed to the weather after installation.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Shingles

Submit data including type, weight, class, UL labels, and special types of underlayment and eave flashing.

SD-04 Samples

Shingles

Full shingle sample and manufacturer's standard size samples of materials and products requiring color or finish selection.

Color charts

SD-08 Manufacturer's Instructions

Application

1.4 DELIVERY AND STORAGE

Deliver materials in the manufacturer's unopened bundles and containers bearing the manufacturer's brand name. Keep materials dry, completely covered, and protected from the weather. Store according to manufacturer's written instructions. Roll goods shall be stored on end in an upright position or in accordance with manufacturer's recommendations. Immediately before laying, roofing felt shall be stored for 24 hours in an area maintained at a temperature not lower than 50 degrees F.

1.5 WARRANTIES

Warranties shall begin on the date of Government acceptance of the work.

1.5.1 Manufacturer's Warranty

Furnish the asphalt shingle manufacturer's standard 30 year warranty for

the asphalt shingles. The warranty shall run directly to the Government.

1.5.2 Contractor's Warranty

The Contractor shall warrant for 5 years that the asphalt shingle roofing system, as installed, is free from defects in workmanship. When repairs due to defective workmanship are required during the Contractor's warranty period, the Contractor shall make such repairs within 72 hours of notification. When repairs are not performed within the specified time, emergency repairs performed by others will not void the warranty.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Shingles

Mineral granule-surfaced asphalt shingles, self-sealing, square tab, strip, fungus-resistant. ASTM D 3018, Type I, and ASTM D 3462, weighing not less than 210 pounds per 100 square feet, architectural shingles weighing not less than 290 pounds per 100 square feet. Shingles shall meet the fire resistance requirements of UL 790 for Class A and the wind resistance requirements of UL 997. Color shall be ____, as selected from the manufacturer's standard color charts. Shingle color shall be in accordance with BASE COLOR SCHEDULE.

2.1.2 Mineral-Surfaced Asphalt Roll Roofing

ASTM D 6380.

2.1.3 Smooth-Surfaced Asphalt Roll Roofing

ASTM D 6380, Type II.

2.1.4 Underlayment

Asphalt-saturated felt conforming to ASTM D 4869 or ASTM D 226, Type I, number 15, Type II, number 30, without perforations or other material specified by the shingle manufacturer for use as underlayment.

2.1.4.1 Leak Barrier Underlayment

Self-adhering leak barrier or ice dam underlayment shall comply with ASTM D 1970 for sealability around nails.

2.1.5 Self-Adhering Membrane

Self-adhering rubberized asphaltic membrane, a minimum of 40 mils thick, and recommended by the shingle manufacturer for use as eaves flashing.

2.1.6 Nails for Applying Shingles and Asphalt-Saturated Felt

Aluminum or hot-dipped galvanized steel or equivalent corrosion resistant with sharp points and flat heads 3/8 to 7/16 inch in diameter. Shank diameter of nails shall be a minimum of 0.105 inch and a maximum of 0.135 inch with garb or otherwise deformed for added pull-out resistance. Nails shall be long enough to penetrate completely through or extend a minimum of 3/4 inch into roof deck, whichever is less, when driven through materials to be fastened.

2.1.7 Asphalt Roof Cement

ASTM D 4586, Type II.

2.1.8 Asphalt Primer

ASTM D 41.

2.1.9 Ventilators

2.1.9.1 Nailable Plastic Shingle Over Type Ridge Vents

Ridge vents shall be constructed of UV stabilized nailable rigid polypropylene material, approximately 1 foot wide and 1 inch thick, and shall be in 4 foot long interlocking sections with self-aligning ends or corrugated polyethylene rigid roll or rigid strip ridge vent with aluminum wind deflectors on each side. Vents shall be designed to prevent infiltration of insects, rain, and snow.

2.1.9.2 Nailable Mesh Shingle Over Type Ridge Vents

Ridge vents shall be constructed of UV stabilized nailable polyester mesh material, approximately one foot wide. Vents shall be designed to prevent infiltration of insects, rain, and snow.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Ensure that roof deck is smooth, clean, dry, and without loose knots. Roof surfaces shall be firm and free from loose boards, large cracks,and projecting ends that might damage the roofing. Vents and other projections through roofs shall be properly flashed and secured in position, and projecting nails shall be driven flush with the deck.

3.2 SURFACE PREPARATION

Cover knotholes and cracks with sheet metal nailed securely to sheathing. Flash and secure vents and other roof projections, and drive projecting nails firmly home.

3.3 APPLICATION

Apply roofing materials as specified herein unless specified or recommended otherwise by shingle manufacturer's written instructions or by NRCA 0408.

3.3.1 Underlayment

Provide for roof slopes 4 inches per foot and greater. Apply one layer of shingle underlayment to roof deck. Lay underlayment parallel to roof eaves, starting at eaves. Provide minimum 2 inch head laps, 4 inch end laps, and 6 inch laps from both sides over hips and ridges. Nail sufficiently to hold until shingles are applied. Turn up vertical surfaces a minimum of 4 inches.

Provide for roof slopes between 2 inches per foot and 4 inches per foot, 4 inches per foot and greater. Apply two layers to roof deck. Provide a 19

inch wide strip as starter sheet to maintain specified number of layers throughout roof. Lay parallel to eaves, starting at eaves. Provide minimum 19 inch head laps, 6 inch laps from both sides over hips and ridges, and 12 inch end laps in the field of the roof. Nail sufficiently to hold until shingles are applied. Turn up vertical surfaces a minimum of 4 inches. When a self-adhering membrane is used for eave flashing, start underlayment from upper edge of eave flashing.

3.3.2 Drip Edges

Provide metal drip edges as specified in Section 07 57 13 FLASHING AND SHEET METAL applied directly on the wood deck at eaves and over the underlayment at rakes. Extend back from edge of deck a minimum of 3 inches, and secure with nails spaced a maximum of 4, 10 inches o.c. along inner edge.

3.3.3 Starter Strip

Apply starter strip at eaves, using 9 inch wide strip of mineral-surfaced roll roofing of a color to match shingles. Optionally, use a row of shingles with tabs removed and trimmed to ensure that joints are not exposed at shingle cutouts. Apply starter strip along eaves, overlaying and finishing even with lower edge of eave flashing strip, overhanging the metal drip edge at eaves and rake edges 1/4 inch to 3/8 inch; fasten in a line parallel to and 3 to 4 inches above eave edge. Place nails so top of nail is not exposed in cutouts of first course of shingles. When roll roofing is provided, seal tabs of first course of shingles with asphalt roof cement. Fasten with 6 nails per strip of shingles or space nails at 6 inches o.c. for roll roofing. Seal tabs of first course of shingles with asphalt roof cement as specified below.

3.3.4 Shingle Courses

Start first course with full shingle, and apply succeeding courses with joints staggered at thirds or halves. Butt-end joints of shingles shall not align vertically more often than every fourth course. Apply shingle courses as follows:

a. Fastening: Do not drive fasteners into or above the factory-applied adhesive unless adhesive is located 5/8 inch or closer to top of cutouts. Place fasteners so they are concealed by shingle top lap and penetrate the head lap.

b. Shingles applied with nails: Nominal 5 inch exposure. Apply each shingle with minimum of four nails. Place one nail one inch from each end, and evenly space nails on a horizontal line a minimum of 5/8 inch above top of cutouts. Cement each tab with one spot of asphalt roof cement placed one to 2 inches from bottom edge of shingle.

c. Nailing: Apply shingles with nominal 5 inch exposure. Apply each shingle with minimum of six nails. Place one nail one inch from each end and one nail on each side of each cutout, on a horizontal line 5/8 inch above cutouts.

d. Sealing: Seal each tab with continuous, 9 inchlong, 1/4 inch diameter bead of asphalt roof cement, applied to the surface of course below. Place bead on horizontal line 5/8 inch above cutouts so bead will be one inch from bottom edge of tab to be

sealed and so bead will not show through cutouts. After nailing each shingle, press tabs down to ensure spreading and bonding of asphalt roof cement.

3.3.5 Hips and Ridges

Form with 9 by 12 inch individual shingles or with 12 by 12 inch shingles cut from 12 by 36 inch strip shingles. Bend shingles lengthwise down center with equal exposure on each side of hip or ridge. Lap shingles to provide a maximum 5 inch exposure, and nail each side in unexposed area 5 1/2 inches from butt and one inch in from edge.

3.3.6 Valleys

Provide either closed cut, woven, open roll roofing, or open sheet metal valleys.

3.3.6.1 Closed Cut Valleys

Provide 36 inch wide valley lining of single layer of smooth-surfaced or mineral-surfaced roll roofing, with mineral-surface facing down, for full length of valley as follows:

a. Center lining in valley over underlayment. Provide minimum 12 inch end laps in the lining and seal laps with asphalt roof cement. Fasten lining to hold it in place until shingles are applied.

b. Apply first regular course of shingles along eaves of one of the intersecting roof planes and across valley. Extend course at least 12 inches onto adjoining roof.

c. Apply succeeding courses in same manner as first course, extending across valley and onto adjoining roof.

d. Press shingles tightly into valley and nail in normal manner, except apply nails not closer than 6 inches to valley centerline, and apply additional nail in top corner of each shingle crossing valley.

e. Apply shingles on the adjoining roof plane, starting along eaves and across valley onto previously applied shingles. Trim overlapping courses back to a line parallel to and a minimum of 2 inches back from valley centerline.

f. Trim one inch on a 45 degree angle from upper corner of each end shingle. Embed end shingles in a 3 inch wide band of asphalt roof cement.

3.3.6.2 Woven Valleys

Provide valley lining as specified for closed cut valley. Lay valley shingles over lining by either of the following methods:

a. Method I: Apply regular shingles on both roofs simultaneously. Weave each course in turn over the valley. Lay the first regular course of shingles along eaves of roof up to and over valley. Extend course along adjoining roof deck at least 12 inches. Carry first regular course of shingles of adjoining roof over valley on top of previously applied shingles. Lay succeeding courses

alternately, weaving valley shingles over each other for full length of valley.

b. Method II: Apply regular shingles on each roof surface separately to a line about 3 feet from center of valley, and weave valley shingles in place later, as specified for Method I.

In following either method, press shingles tightly into valley, and fasten in normal manner; except apply nails not closer than 6 inches to valley centerline, and apply additional nail in top corner of terminal shingle on both sides of valley.

3.3.6.3 Open Roll Roofing Valleys

Provide 18 inch wide strip of mineral-surfaced asphalt roll roofing, of a color to blend with asphalt shingles, and with granular surface facing down, for the full length of valley as follows:

a. Center roll roofing strip in valley over underlayment. Lay centered in valley over felt underlayment and with granular face down. Nail strip only enough to hold in place. Apply nails in rows one inch from each edge. As fastening along second side proceeds, press strip firmly into valley.

b. Center second strip 36 inches wide in valley and lay it over first strip with granular face exposed and nail as specified for 18 inch strip.

c. Before applying roofing shingles, snap two chalk lines for full length of valley. Locate each line 3 inches from centerline of valley at top, and increase width between lines by one inch for each 8 feet of valley length, continuing to eaves.

d. Apply a 2 inch band of asphalt roof cement along each edge of 36 inch strip from edge to chalk line. Cut regular shingle courses true along valley chalk lines, and nail in normal manner.

3.3.6.4 Open Sheet Metal Valleys

Sheet metal flashing for valleys is specified in Section 07 57 13 FLASHING AND SHEET METAL. Before installing and fastening flashing in place with metal cleats:

a. Install single layer of 36 inch wide, asphalt-saturated felt, centered on valley and extending entire length of valley over felt underlayment.

b. Cut regular shingle courses on each roof on true line 2 inches from valley centerline at top of valley, and increase width between lines by one inch for each 8 feet of valley length, continuing to eaves.

c. Apply 2 inch band of asphalt roof cement over flashing, along and under side of shingles adjoining valley.

d. Press shingles tightly into cement, and nail in normal manner, except apply nails not closer than 5 inches to valley centerline. Do not drive nails through valley flashing.

e. Provide a 4 inch band of asphalt roof cement for fastening shingle tabs down along open metal gutters.

3.3.7 Flashing

3.3.7.1 Eave Flashing

Provide for roof slopes 4 inches per foot and greater. Provide eave flashing strips consisting of smooth-surfaced roll roofing. Flashing strips shall overhang metal drip edge 1/4 inch to 3/8 inch and extend up the slope far enough to cover a point 12 inches inside interior face of exterior wall. Where overhangs require flashings wider than 36 inches, locate laps outside exterior wall face. Laps shall be at least 2 inches wide and cemented with asphalt roof cement over entire length of lap. Lap end 12 inches and cement.

Provide for roof slopes between 2 inches per foot and 4 inches per foot, 4 inches per foot and greater. Provide either of the following types of eave flashing:

a. From the eaves to a point 24 inches inside interior wall line, apply solid coating of asphalt roof cement between overlapping layers of underlayment. Spread cement to a uniform thickness at rate of 2 gallons per 100 square feet of cemented roof area.

b. From the eaves to a point 24 inches inside interior wall line, apply one layer of self-adhering membrane. Follow membrane manufacturer's printed installation instructions.

3.3.7.2 Stepped Flashing

For sloping roofs which abut vertical surfaces, provide stepped metal flashing as specified in Section 07 57 13 FLASHING AND SHEET METAL.

3.3.7.3 Vent and Stack Flashing

Apply shingles up to point where vent or stack pipe projects through roof, and cut nearest shingle to fit around pipe. Before applying shingles beyond pipe, prepare flange of metal pipe vent flashing as specified in Section 07 57 13 FLASHING AND SHEET METAL, by applying a 1/8 inch thick coating of asphalt roof cement on bottom side of flashing flange. Slip flashing collar and flange over pipe, and set coated flange in 1/16 inch coating of asphalt roof cement. After applying flashing flange, continue shingling up roof. Lap lower part of flange over shingles. Overlap flange with side and upper shingles. Fit shingles around pipe, and embed in 1/16 inch thick coating of asphalt roof cement where shingles overlay flange.

3.3.7.4 Chimney Flashing

Provide treated wood crickets as specified in Section 06 10 00 ROUGH CARPENTRY. Provide metal base and counterflashing as specified in Section 07 57 13 FLASHING AND SHEET METAL. Uniformly coat masonry surfaces which are to receive flashing with asphalt primer applied at rate of one gallon per 100 square feet. Apply shingles over underlayment up to front face of chimney. Apply metal front base flashing with lower section extending at least 4 inches over shingles. Set base flashing in a 1/16 inch coating of asphalt roof cement on shingles and chimney face. Apply metal step flashing at sides in a coating of asphalt roof cement. Embed end shingles in each course that overlaps step flashing with asphalt roof cement. Apply

metal rear base flashing over cricket and back of chimney in coating of asphalt roof cement. Apply end shingles in each course up to cricket, and cement in place. Lap base flashing minimum of 3 inches with metal counterflashing.

-- End of Section --

SECTION 07 40 00

SOLID VINYL SIDING WORK
(Aluminum Soffit and Trim is Included)

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM D 3679	(1999) Rigid Poly (Vinyl Chloride) (PVC) Siding

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-W-365	(Rev. A; Int Am 1) Wire Fabric (Insect Screening)

1.2 SUBMITTALS

Submit in following in accordance with Section 01 33 00, "Submittal Procedures."

SD-04 Samples

Custom trim shapes

A sample of each standard shape and a sample of each custom trim shape 12 inches long shall be submitted to and approved by the Contracting Officer

SD-07 Certificates

Vinyl siding

Inside corner posts

Outside corner posts

"J" channels

Sill trim

Other accessories

Manufacturer's certificates or test reports shall be submitted indicating that the vinyl siding, inside corner posts, outside

corner posts, "J" channel, sill trim, and other accessories meet the requirements of ASTM D 3679, and that aluminum accessories and custom trim shapes meet requirements of ASTM B 209

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers, with brand name clearly marked thereon. All materials shall be carefully handled and stored to prevent damage.

PART 2 PRODUCTS

2.1 VINYL SIDING

The siding shall be rigid polyvinyl chloride horizontal lap siding of patterns indicated, conforming to ASTM D 3679, Class 2, except as otherwise specified herein. The siding and trim shall be made from a powder, not pellet, base. The vinyl shall have a minimum thickness of 0.040 inches. The color shall be as indicated and distributed throughout the thickness of the vinyl. The surface texture shall be as indicated. Where 3 colors are indicated, the color for each building shall be as directed by the Contracting Officer. The nailing hem shall have a protective ridge or other device to prevent over driving of nails. Nail slots shall be elongated to allow for horizontal expansion and contraction.

2.2 INSIDE CORNER POSTS, OUTSIDE CORNER POSTS, ETC.

Inside corner posts, outside corner posts, starter strips, sill trim, "J" Channels, and other trim as required shall be rigid polyvinyl chloride and shall be of appropriate size and construction to accept the siding without loose joints or unsightly reveals.

2.3 BACKER PLATES

The backer plates shall be 8 inch aluminum suitable to backup laps or other strategic points for a smooth installation.

2.4 CUSTOM TRIM SHAPES AND OTHER ACCESSORIES

Shall be aluminum, 0.019 inch thickness with factory applied vinyl finish. Custom trim shapes shall be factory or site fabricated with a mechanical breaking machine in minimum lengths of 8 feet. Working tolerances for custom shapes shall be plus or minus 1/32 inch.

2.4.1 Finish Coating System

Factory-applied, minimum total dry film thickness of 1.0 mil, available in a minimum of six manufacturer's standard colors. Provide finish coating system on the exterior face. The interior face may receive an acrylic wash coat applied to a minimum total dry film thickness of 0.20 mil. Color shall be as selected from manufacturer's standard colors.

2.4.2 Accessories

Sheet metal flashings, trim, moldings, closure strips, caps, and other similar sheet metal accessories used in conjunction with preformed metal panels shall be made of the same material and finish as used for the panels. Thickness of the metal shall be not less than that used for the siding. Molded closure strips shall be closed-cell or solid-cell synthetic

rubber, neoprene, or polyvinyl chloride premolded to match the configurations of the preformed metal panels.

2.4.3 Fasteners for attaching siding and accessories

Fasteners for attaching siding and accessories to adjoining panels shall be as approved and in accordance with the manufacturer's recommendations. Unless specified otherwise, the fasteners shall be either self-tapping screws, bolts and nuts, self-locking rivets, self-locking bolts, end-welded studs, bolted or riveted studs, or step rivets held by aluminum straps. Design the fastening system to withstand the design loads indicated. Fasteners shall be Series 305 stainless steel or aluminum. Fasteners, with the exception of those having integral hexagonal washer heads and those having aluminum drive caps, shall have composite metal and neoprene washers. Fasteners having integral hexagonal washer heads and fasteners having aluminum drive caps shall have polychloroprene washers. Heads of screws or bolts exposed on exterior face of factory-finished wall shall be nylon headed to match color of wall.

2.5 POP RIVETS

Shall be used to secure corners or joints which cannot be secured by nailing to backup materials and shall be aluminum or material which is non-reactive with aluminum.

2.6 NAILS

Aluminum or galvanized steel, with 5/16-inch head for siding, 7/16-inch head for insulation and 0.125 inch diameter, and of length required to penetrate existing wood 3/4 inch.

2.7 EXPOSED NAILS

Nails which will be exposed in the finish work shall have a 3/32-inch head or smaller and shall be color matched to the material being nailed.

2.8 FURRING STRIPS

Treated wood furring strips.

2.9 SHEATHING/INSULATION

Extruded polystyrene boards, Type II, Class B, or Type II, Class A, with aluminum foil bonded to both sides. Boards shall have a "C" Factor of not more than 0.27 at 75 degrees F. mean temperature.

2.10 LOUVERS

Shall be fabricated of extruded aluminum to fit openings from which existing wood louvers are removed. Extruded sections for blades and frames shall have wall thickness of not less than 0.064 inch and shall have longitudinal ridges to prevent sagging and bowing. Louvers shall be designed and constructed so as to prevent entrance of water into the attic space. Corners of frames and intersections of blades with frames shall be welded or mechanically fastened and made watertight with sealant specified in section "Calking". All exposed aluminum surfaces shall be cleaned, treated, primed, and given a white vinyl finish, with total dry film thickness not less than 0.8 mils. Provide insect screening conforming to FS RR-W-365, 18 by 18 mesh.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Drive in loose nails in existing siding and wood trim. If any existing wood or plywood to be covered by vinyl shows evidence of rotting, the Contractor shall inform the Contracting Officer. Prior to installation of insulation and siding, deteriorated wood and plywood shall be removed and new wood or plywood shall be provided as directed by the Contracting Officer. The cost of such work performed at the direction of the Contracting Officer will be paid for by adjustment of the contract price in accordance with the Contract Clauses.

3.2 FURRING STRIPS

Shall be provided around openings and as required to level out irregular ities.

3.3 SHEATHING/INSULATION

Nail foam board to existing siding with 3 to 5 nails per board. Boards shall be level and carefully fitted. Tongue and groove edges shall be snugly engaged.

3.4 SIDING

Apply starter strip in a true and level manner with nails 16 inches on center making sure that nails are in the center of nailing slots. Apply inside and outside corners similarly. Where still trim is used, lock punch siding 12 inches on center to lock. Hang siding with one nail at 16 inches on center. DO NOT DRIVE NAILS TIGHT. A minimum of 1/32-inch must be left between the nail and siding to allow for horizontal movement. Allow 3/16-inch between ends of siding and bottom of trim throat for expansion. Ends of siding and trim shall not be left open, but shall have metal or vinyl closures applied, or in the case of small open ends such as custom drip caps, the ends shall be calked and smoothed. If vinyl is required to be bent, the bend shall be accomplished with a heated mechanical break. Open flame shall not be used. Joints in siding shall be staggered vertically and shall occur at 8 foot intervals or greater horizontally. Backer plates shall be used behind joints in trim and where required to produce a smooth installation.

3.5 CUSTOM TRIM

Shall be fabricated to a tolerance of plus or minus 1/32-inch with a mechanical breaking apparatus in lengths of 8 feet or longer. The trim shall be nailed with small color matched aluminum nails and shall be blind nailed where possible. Exposed cut ends or edges shall be calked against the abutting material to make a smooth transition. Where splices in trim are required they shall be lapped in shingle fashion to repel water, and where there is no backup material for nailing, the trim shall be pop riveted as required to make a smooth joint without unsightly reveals or puckers.

3.6 GABLE LOUVERS

Shall be securely fastened into existing louver openings and trimmed and calked as required to produce a weathertight installation.

3.7 PROTECTION AND CLEANING

The Contractor shall take such measures as required to protect his work from damage and upon completion of work, all stains, smears, and other soiling shall be removed and the work left in clean and neat condition. The Contractor shall clean the site of construction debris daily.

-- End of Section --

SECTION 07 41 13

METAL ROOF PANELS

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA ADM1	(2005; Errata 2005) Aluminum Design Manual

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341	(2005; Supp 2001) Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002) Cold-Formed Steel Design Manual Set
AISI/COS/NASPEC	(2001, Supplement 2004) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05	(2006) Minimum Design Loads for Buildings and Other Structures, Including Supplement No. 1

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2003; Errata 2004) Structural Welding Code - Aluminum

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1008/A 1008M	(2007a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 123/A 123M	(2002) Standard Specification for Zinc

	(Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 424	(2006) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A 463/A 463M	(2006) Standard Specification for Steel Sheet, Aluminum-Coated
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 755/A 755M	(2003) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 792/A 792M	(2006a) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A 924/A 924M	(2007) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(2007) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 286	(1999; 2004) Standard Terminology Relating to Porcelain Enamel and Ceramic-Metal Systems
ASTM C 552	(2007) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 553	(2002) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 792	(2004) Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

ASTM D 1308	(2002; R 2007) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(2005) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 1970	(2001) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 2244	(2007) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 2794	(1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM D 3363	(2005) Film Hardness by Pencil Test
ASTM D 4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4587	(2005) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D 4637	(2004) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Standard Test Method for Specular Gloss
ASTM D 5894	(2005) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610	(2007) Evaluating Degree of Rusting on Painted Steel Surfaces

ASTM D 714	(2002e1) Evaluating Degree of Blistering of Paints
ASTM D 822	(2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D 968	(2005e1) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	(2005) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 2140	(2001) Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM 4471	(1995) Class I Panel Roofs

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA RSDM	(2000) Metal Roofing Systems Design Manual

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0405	(2001; R 2003, 5th Ed) Roofing and Waterproofing Manual
NRCA ASMMRM	(2006) Architectural Sheet Metal and Metal Roofing Manual

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI 1001	(1996) Specification for Architectural Porcelain Enamel (ALS-100)
PEI CG-3	(2005) Color Guide for Architectural Porcelain Enamel

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2006) Architectural Sheet Metal Manual, Sixth Edition, Second Printing

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 12	(1982; E 2000) Paint Specification No. 12

	Cold-Applied Asphalt Mastic (Extra Thick Film)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-P-28578	(Rev B; CANC Notice 1) Paint, Water-Borne, Acrylic or Modified Acrylic, Semi-Gloss, for Metal Surfaces

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006) Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	(2007) Building Materials Directory

1.2 DESCRIPTION OF METAL ROOF SYSTEM

1.2.1 Performance Requirements

Steel panels and accessory components must conform to the following standards:

ASTM A 1008/A 1008M
ASTM A 123/A 123M
ASTM A 36/A 36M
ASTM A 424, ASTM C 286, PEI 1001, PEI CG-3 for Porcelain and Ceramic Enameling
ASTM A 463/A 463M for aluminum coated steel sheet
ASTM A 755/A 755M for metallic coated steel sheet for exterior coil prepainted applications.
ASTM A 924/A 924M for metallic coated steel sheet
ASTM D 522 for applied coatings
UL Bld Mat Dir

1.2.1.1 Hydrostatic Head Resistance

No water penetration when tested according to ASTM E 2140. Submit leakage test report upon completion of installation.

1.2.1.2 Wind Uplift Resistance

Provide metal roof panel system that conform to the requirements of ASTM E 1592 and UL 580. Uplift force due to wind action governs the design for panels. Submit wind uplift test report prior to commencing installation.

Roof system and attachments must resist the wind loads as determined by ASCI/SEI 7-05, in pounds per square foot. Metal roof panels and compnent materials must also comply with the requirements in FM 4471 as part of a panel roofing system as listed in Factory Mutual Guide (FMG) "Approval Guide" for class 1 or noncombustible construction, as applicable. Identify all materials with FMG markings.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing Panels

Flashing and Accessories

Gutter/Downspout Assembly

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Roof panels

FACTORY-APPLIED COLOR FINISH

Accessories

Fasteners

Pressure Sensitive Tape

UNDERLAYMENTS

Gaskets and Sealing/Insulating Compounds

Coil Stock

Aluminized Steel Repair Paint

Enamel Repair Paint

Galvanizing Repair Paint

SD-04 Samples

Roof Panels

Factory-applied Color Finish, samples, 9 inch lengths, full width

Accessories

Fasteners

Gaskets and Sealant/Insulating Compounds

SD-05 Design Data

Wind Uplift Resistance

SD-06 Test Reports

Leakage Test Report

Wind Uplift Test Report

Fire Rating Test Report

Factory Finish and Color Performance Requirements

SD-07 Certificates

Roof Panels

Coil stock compatibility

Self-Adhering Modified Bitumen Underlayment

Qualification of Manufacturer

Qualification of Applicator

SD-08 Manufacturer's Instructions

INSULATION

INSTALLATION MANUAL

SD-09 Manufacturer's Field Reports

Manufacturer's Field Inspection Reports

SD-11 Closeout Submittals

Warranties

Information Card

Date Of Installation Wall-Mounted Placard

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Submit documentation verifying metal roof panel manufacturer has been in the business of manufacturing metal roof panels for a period of not less than 5 years.

Manufacturer must also provide engineering services by an authorized engineer, currently licensed in the geographic area of the project, with aminimum of five (5) years experience as an engineer knowledgeable in roof wind design analysis, protocols and procedures for MBMA RSDM, ASCE/SEI 7-05, UL 580, and FM 4471. Engineer must provide certified engineering calculations for the project conforming to the stated references.

1.4.1.1 Manufacturer's Technical Representative

The manufacturer's technical representative must be thoroughly familiar with the products to be installed, installation requirements and practices, and with any special considerations in the geographical area of the project. The representative must perform field inspections and attend meetings as specified.

1.4.1.2 Single Source

Roofing panels, clips, closures, and other accessories must be standard products of the same manufacturer, and the most recnt design of the manufacturer to operate as a complete system for the intended use.

1.4.2 Qualification of Applicator

Metal roof system applicator must be approved, authorized, or licensed in writing by the roof panel manufacturer and have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer, approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of 5 projects of similar size and scope constructed by applicator using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Field Verification

Prior to the preparation of drawings and fabrication, verify location of roof framing, roof openings and penetrations, and any other special conditions. Indicate all special conditions and measurements on final shop drawings.

1.4.4 Qualifications for Welding Work

Welding procedures must conform to AWS D1.1/D1.1Mfor steel or AWS D1.2/D1.2M for aluminum.

Operators are permitted to make only those types of weldments for which each is specifically qualified.

1.4.5 Pre-roofing Conference

After approval of submittals and before performing roofing system installation work, hold a pre-roofing conference to review the following:

a. Drawings, specifications, and submittals related to the roof work. Submit, as a minimum; sample profiles of roofing panels, with factory-applied color finish samples, flashing and accessories, gutter/downspout assembly samples, typical fasteners and pressure sensitive tape, sample gaskets and sealant/insulating compounds. Also include data and 1/2 pint sample of aluminized steel repair paint, enamel repair paint, galvanizing repair paint, and technical data on coil stock and coil stock compatibility, and manufacturer's installation manual.

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Coordinate pre-roofing conference scheduling with the Contracting Officer. Attendance is mandatory for the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of metal roof system, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, and representative of the metal roofing manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, HANDLING, AND STORAGE

Deliver, store, and handle panel materials, bulk roofing products, accessories, and other manufactured items in a manner to prevent damage and deformation, as recommended by the manufacturer, and as specified.

1.5.1 Delivery

Package and deliver materials to the site in undamaged condition. Provide adequate packaging to protect materials during shipment. Do not uncrate materials until ready for use, except for inspection. Immediately upon arrival of materials at jobsite, inspect materials for damage, deformation, dampness, and staining. Remove affected materials from the siteand immediately replace.. Remove moisture from wet materials not otherwise affected, restack and protect from further moisture exposure.

1.5.2 Handling

Handle materials in a manner to avoid damage. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.5.3 Storage

Stack materials stored on site on platforms or pallets, and cover with tarpaulins or other weathertight covering which prevents trapping of water or condensation under the covering. Store roof panels so that water which may have accumulated during transit or storage will drain off. Do not store panels in contact with materials that might cause staining. Secure coverings and stored items to protect from wind displacement.

1.6 PROJECT CONDITIONS

Weather Limitations: Proceed with installation only when existing and forcast weather conditions permit meatl roof panel work to be performed according to manufacturer's written instructions and warranty requirements, and specified safety requirements.

1.7 FABRICATION

Fabricate and finish metal roof panels and accessories on a factory stationary industrial type, leased or installer owned portable, rolling mill to the greatest extent possible, per manufacturer's standard procedures and processes, and as necessay to fulfill indicated performance requirements. Comply with indicated profiles, dimensional and structural requirements.

Provide panel profile, as indicated on drawings including major ribs and intermediate stiffening ribs for full length of panel. Fabricate panel side laps with factory installed captive gaskets, separator strips

providing a weather tight seal and preventing metal-to metal contact, and minimizing noise from movements within the panel assembly.

1.7.1 Finishes

Finish quality and application processes must conform to the related standards specified within this section. Noticeable variations within the same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize any contrasting variations.

1.7.2 Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 as applicable to the design, dimensions, metal, and other characteristics of the item indicated.

a. Form exposed sheet metal accessories which are free from excessive oil canning, buckling, and tool marks, and are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: Form non-expansion, but movable joints in metal to accomodate elastomeric sealant to comply with SMACNA 1793.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachments devices of size and metal thickness recommended by SMACNA or by metal roof panel manufacturer for application, but not less than the thickness of the metal being secured.

1.8 WARRANTIES

Provide metal roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to manufacturer's standard warranty as required to comply with the specified requirements.

1.8.1 Metal Roof Panel Manufacturer Warranty

Furnish the metal roof panel manufacturer's 5, 10, 20, 30-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, components, trim, and accessories necessary for a watertight roof system construction. Make warranty directly to the Government, commencing at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period, the metal roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, displaces, corrodes, perforates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the metal roof system and correction of defective workmanship is the responsibility of the

metal roof panel manufacturer. All costs associated with the repair or replacement work are the responsibility of the metal roof panel manufacturer.

b. If the manufacturer or his approved applicator fail to perform the repairs within 24, 48, 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.8.2 Manufacturer's Finish Warranty

Provide a manufacturer's no-dollar-limit 20 year warranty for the roofing system. Issue the warranty directly to the Government at the date of Government acceptance.warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244.

1.8.3 Metal Roof System Installer Warranty

Provide the "Contractors Twenty (20) Year No Penal Sum Warranty for Non-Structural Metal Roof System" attached at the end of this section. Provide a separate bond in an amount equal to the installed total material and installation roofing system cost in favor of the Government covering the installer's warranty responsibilities effective throughout the five, ten, twenty, (5, 10, 20) year warranty period.

Provide roof system installer warranty for a period of not less than two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof panel installation, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Issue warranty directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials is the responsibility of the metal roof system installer. All costs associated with the repair or replacement work are the responsibility of the installer.

1.8.4 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the metal roof system manufacturer warranty for the remainder of the manufacturer warranty period.

1.9 CONFORMANCE AND COMPATIBILITY

The entire metal roofing and flashing system must be in accordance with specified and indicated requirements, including wind resistance and seismic per AISC 341 requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the MBMA RSDM, NRCA 0405, the metal panel manufacturer's published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

1.10 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of English unit measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The English and metric units for the measurements shown are as follows:

	PRODUCTS	ENGLISH UNITS	METRIC UNITS
a.	Sheet Aluminum	0.040 inch	1.0 mm
b.	Panels	12 inches	300 mm
	- vertical legs	2 inches	50 mm
	- stiffening ribs	4 inches	100 mm
c.	Screws	No. 14	0.242 mm
		No. 12	0.216 mm
d.	Bolts	1/4 inch	6 mm
e.	Studs	3/16 inch	5 mm
f.	Fasteners	1/2 inch	13 mm
		One inch	25 mm
g.	Rivets	1/16 inch	5 mm
		1/8 inch	3 mm

PART 2 PRODUCTS

2.1 ROOF PANELS

2.1.1 Aluminum Sheet Panels

Roll-form aluminum roof panels to the specified profile, with fy = 30, 40, 50, 80 ksi, .032, .040, .050 thickness and depth as indicated.

Material must be plumb and true, and within the tolerances listed:

a. Aluminum sheet conforming to ASTM B 209, and AA ADM1

b. Individual panels to have continuous length sufficient to cover the entire length of any unbroken roof slope with no joints or seams and formed without warping, waviness, or ripples that are not a part of the panel profile and free from damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified, and the following profile:

i. profile and coverage to be a minimum height and width from the manufacturer's standard for the indicated roof slope.

ii. profile to be a 1-1/2 inch high rib at 12 inches o.c. with small stiffening ribs, 38 inch overall panel width with 36 inch exposed panel and exposed fasteners.

iii. profile to be a 1-1/2 inch high rib at 7.2 inches o.c.; 38-7/8 inch overall width with 36 inch exposed panel and exposed fasteners.

iv. profile to be a 1 inch high rib at 4 inches o.c.; 49-5/8 inch overall width with 48, 44 inch exposed panel and exposed fasteners.

v. profile to be a 1 inch high rib at 8 inches o.c.; 41-5/8 inch overall width with 40 inch exposed panel and exposed fasteners.

vi. profile to be a 1-3/4 inch high V-beam rib at 5 inches o.c.; 44-7/8 inch overall width with 42 inch exposed panel and exposed fasteners.

vii. profile to be a 7/8 inch high corrugated rib at 2 inches o.c., 38-7/8 inch overall width with 36 inch exposed panel and exposed fasteners.

viii. profile to be a 3 inch high standing seam, 24 inch coverage, factory-caulked and mechanical crimping or snap-together seams with concealed clips and fasteners.

ix. profile to be a 1, 1-3/4, 2, 2-1/2 inch high standing seam, 12, 16, 18, 24 inch coverage with mechanical crimping or snap-together seams with concealed clips and fasteners.

x. profile to be smooth, flat embossed pattern, textured surface.

xi. profile to be custom, as shown on drawings.

2.1.2 Steel Sheet Panels

Roll-form steel sheet roof panels to the specified profile, with fy = 30, 40, 50, 80 ksi, 26, 24, 22, 20, 18 gauge and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Galvanized steel sheet conforming to ASTM A 653/A 653M and AISI SG03-3.

b. Aluminum-Zinc alloy coated steel sheet conforming to ASTM A 792/A 792M and AISI SG03-3.

c. Individual panels to have continuous length sufficient to cover the entire length of any unbroken roof slope with no joints or seams and formed without warping, waviness, or ripples that are not a part of the panel profile and free from damage to the finish coating system.

d. Provide panels with thermal expansion and contraction consistent with the type of system specified, and the following profile:.

i. profile and coverage to be a minimum height and width from the manufacturer's standard for the indicated roof slope.

ii. profile to be a 1-1/2 inch high rib at 12 inches o.c. with small stiffening ribs, 38 inch overall panel width with 36 inch exposed panel and exposed fasteners.

iii. profile to be a 1-1/2 inch high rib at 7.2 inches o.c.; 38-7/8 inch overall width with 36 inch exposed panel and exposed fasteners.

iv. profile to be a 1 inch high rib at 4 inches o.c.; 49-5/8 inch

overall width with 48, 44 inch exposed panel and exposed fasteners.

v. profile to be a 1 inch high rib at 8 inches o.c.; 41-5/8 inch overall width with 40 inch exposed panel and exposed fasteners.

vi. profile to be a 1-3/4 inch high V-beam rib at 5 inches o.c.; 44-7/8 inch overall width with 42 inch exposed panel and exposed fasteners.

vii. profile to be a 7/8 inch high corrugated rib at 2 inches o.c., 38-7/8 inch overall width with 36 inch exposed panel and exposed fasteners.

viii. profile to be a 1, 1-3/4, 2, 2-1/2 inch high standing seam, 12, 16, 18, 24 inch coverage with mechanical crimping or snap-together seams with concealed clips and fasteners.

ix. profile to be smooth, flat embossed pattern, textured surface.

x. profile to be custom, as shown on drawings.

2.2 FACTORY FINISH AND COLOR PERFORMANCE REQUIREMENTS

All panels are to receive a factory applied Kynar 500/Hylar 5000 finish consisting of a baked topcoat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with an acid rinse, and thorough drying.

b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 + 0.05 mils. The prime coat must be oven cured prior to application of the finish coat.

c. Exterior Finish Coating: Apply the exterior finish coating over the primer by roll coating to a dry film thickness of 0.80 + 0.05 mils (3.80 + 0.05 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 +0.10 mils (4.00 + 0.10 mils for Vinyl Plastisol). This exterior finish coat must be oven-cured.

d. Interior finish coating: Apply a wash coat on the reverse side over primer by roll coating to a dry film thickness of 0.30 + 0.05 mils for a total dry fill thickness of 0.50 +0.10 mils. The wash coat must be oven cured.

e. Color: The exterior finish chosen from the manufacturer's standard color chart.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General: SSPC Paint 12, MIL-P-28578, ASTM D 5894, and ASTM D 4587.

Abrasion: ASTM D 968
Adhesion: ASTM D 3359
Chalking: ASTM D 4214
Chemical Pollution: ASTM D 1308
Color Change and Conformity: ASTM D 2244
Creepage: ASTM D 1654
Cyclic Corrosion Test: ASTM D 5894
Flame Spread: ASTM E 84
Flexibility: ASTM D 522
Formability: ASTM D 522
Gloss at 60 and 85 degrees: ASTM D 523
Humidity: ASTM D 2247 and ASTM D 714
Oxidation: ASTM D 610
Pencil Hardness: ASTM D 3363
Reverse Impact: ASTM D 2794
Salt Spray: ASTM B 117
Weatherometer: ASTM G 23 and ASTM D 822

2.2.1 Specular Gloss

Finished roof surfaces to have a specular gloss value of 30 plus or minus 5 at an angle of 60 degrees, 10 or less at an angle of 85 degrees when measured in accordance with ASTM D 523.

2.3 MISCELLANEOUS METAL FRAMING

2.3.1 General

Provide cold formed metallic-coated steel sheet conforming to ASTM A 653/A 653M, AISI/COS/NASPEC, and as specified in 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.3.2 Fasteners and Miscellaneous Metal Framing

Provide compatible type, corrosion resistant, of sufficient size and length to penetrate the supporting element a minimum of one inch with other required properties to fasten miscellaneous metal framing members to substrates in accordance with the roof panel manufacturer's and ASCE/SEI 7-05 requirements.

2.3.2.1 Exposed Fasteners

Fasteners for roof panels must be corrosion resistant coated steel, aluminum, stainless steel, nylon capped steel, compatible with the sheet panel or flashing material and of the type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories must be the manufacturer's standard. Provide an integral metal washer, matching the color of attached material with compressible sealing epdm gasket approximately 3/32 inch thick for exposed fasteners.

2.3.2.2 Screws

Provide corrosion resistant screws, coated steel, aluminum, stainless steel of the type and size recommended by the manufacturer to meet the performance requirements.

2.3.2.3 Rivets

Provide closed-end type rivets, corrosion resistant coated steel, aluminum, stainless steel where watertight connections are required.

2.3.2.4 Attachment Clips

Provide hot-dip galvanized, conforming to ASTM A 653/A 653M, stainless steel, series 300 clips. Size, shape, thickness and capacity must meet the thickness and design load criteria specified.

2.3.3 Electrodes for Manual, Shielded Metal Arc Welding

Electrodes for manual, shielded metal arc welding must meet the requirements of AWS D1.1/D1.1M, and be covered, mild-steel electrodes conforming to AWS A5.1/A5.1M.

2.4 ACCESSORIES

Accessories must be compatible with the metal roof panels. Sheet metal flashing, trim, metal closure strips, caps, and similar metal accessories must be not less than the minimum thicknesses specified for roof panels. Provide exposed metal accessories to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips must be closed-cell or solid-cell synthetic rubber or neoprene premolded to match configuration of the panels and not absorb or retain water.

2.4.1 Pre-manufactured Accessories

Pre-manufactured accessories must be manufacturer's standard for intended purpose, comply with applicable specification section, compatible with the metal roof system and approved for use by the metal roof panel manufacturer. Construct curbs to match roof slope.

2.4.2 Metal Closure Strips

Provide factory fabricated aluminum closure strips, steel closure strips of the same gauge, thickness, color, finish and profile as the specified roof panel.

2.4.3 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber closure strips conforming to ASTM D 1056 and ASTM D 1667, extruded or molded to the configuration of the specified roof panel profile and in lengths supplied by roof panel manufacturer.

2.4.4 Subgirts for Retrofits

Provide bar subgirts 1-1/2- by 1/8 inch galvanized steel with slotted holes for welding to end of impaling clip spikes.

2.5 JOINT SEALANTS

2.5.1 Sealants

Sealants are to be an approved gun type for use in hand or air pressure caulking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F) with a minimum solid

content of 85 percent of the total volume. Sealant must dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather tight joint. No migratory staining, in conformance with to ASTM C 792, is permitted on painted or unpainted metal, stone, glass, vinyl or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the roof panel manufacturer.

2.5.1.1 Shop Applied Sealants

Sealant for shop-applied caulking must be an approved gun grade, non-sag one-component polysulfide or silicone conforming to ASTM C 792 and ASTM C 920, Type II, with a curing time which ensures the sealants plasticity at the time of field erection. Color to match panel color.

2.5.1.2 Field Applied Sealants

Sealants for field-applied caulking must be an approved gun grade, non-sag on-component polysulfide or two component polyurethane with an initial maximum Shore A durometer hardness of 25, conforming to ASTM C 920, Type II. Color to match panel color.

2.5.1.3 Tape Sealants

Provide pressure sensitive, 100 percent solid tape sealant with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the roof panel manufacturer.

2.5.2 Sheet Metal Flashing and Trim

2.5.2.1 Fabrication, General

Custom fabricate sheet metal flashing and trim to comply with recommendations within the SMACNA 1793 that apply to design, dimensions, metal type, and other characteristics of design indicated. Shop fabricate items to the greatest extent possible. Obtain and verify field measurements for accurate fit prior to shop fabrication. Fabricate flashing and trim without excessive oil canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

2.5.2.2 Roof Drainage Sheet Metal Fabrications

Gutters: Fabricate to cross section indicated, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96 inch long sections. Fabricate expansion joints and accessories from the same metal as gutters, unless otherwise indicated.

Downspouts: Fabricate circular, rectangular, square downspouts complete with mitered elbows. Furnish with metal hangars of same material as downspouts and anchors.

2.6 INSULATION

Insulation, facer material and attachment must be compatible with metal roof system specified, as approved by the roof panel manufacturer, and conform to ASTM C 552 (cellular glass) or ASTM C 553 (fiber blankets).

2.6.1 Fire Rated Assembly System

Provide semi-rigid glass-fiber insulation board conforming to ASTM C 553, Form A, Class 1, Class A fire-hazard classification with a minimum density of 1.55 pounds per cubic foot (pcf), and 1-1/2 inches thick. Thermal conductivity (K) must not exceed 0.24.

2.6.2 Fire Rated Roof Panel Assembly

Provide materials for fire-rated roof panel construction as follows:

Impaling clips, accessories, and fasteners must be UL listed 40 U18.24 UL Bld Mat Dir galvanized steel sheet or impaling bolts welded to each wall unit joint and spaced not more than 48 inches on center.

Provide bar subgirts 1-1/2- by 1/8 inch galvanized steel with slotted holes for welding to end of impaling clip spikes.

Provide galvanized steel structural angles and flashing angles, gage or thickness as indicated, or material as specified. Flashing angles must be not less than No. 18 U.S. standard gage.

Provide hot-dip galvanized steel metal facing conforming to ASTM A 653/A 653M, Grade A. Coating must conform to, ASTM A 653/A 653M and ASTM A 924/A 924M.

Metal facing must be as indicated and fabricated of enamel-coated hot-dip galvanized steel conforming to ASTM A 653/A 653M, Grade A. Coating must conform to ASTM A 653/A 653M and ASTM A 924/A 924M. Provide Class A fire hazard classification finish. Flame spread, fuel contributed, or smoke developed cannot exceed a value of 25.

Submit fire rating test report to contracting officer for review and approval. Secure written approval prior to commencement of installation.

2.7 UNDERLAYMENTS

2.7.1 Felt Underlayment

Provide No. 30 asphalt-saturated organic , non-perforated felt underlayment in compliance with ASTM D 226, Type II, or ASTM D 4869.

2.7.2 Self-Adhering Modified Bitumen Underlayment

Provide self-adhering modified bitumen membrane underlayment material in compliance with ASTM D 1970, suitable for use as underlayment for metal roofing. Use membrane resistant to cyclical elevated temperatures for extended period of time in high heat service conditions. Provide membrane with integral non-tacking top surface of polyethylene film or other surface material to serve as separator between bituminous material and metal products to be applied above.

2.7.3 EPDM Membrane

Ethylene Propylene Diene Terpolymer (EPDM), ASTM D 4637, Type I, non-reinforced, minimum 1.1 mm (0.045 inch) thick.

2.7.4 Slip Sheet

Provide 0.24 kg per square meter (5 pounds per 100 sf) rosin sized unsaturated building paper for slip sheet.

2.8 GASKETS AND SEALING/INSULATING COMPOUNDS

Gaskets and sealing/insulating compounds must be nonabsorptive and suitable for insulating contact points of incompatible materials. Sealing/insulating compounds must be non-running after drying.

2.9 FINISH REPAIR MATERIAL

Repair paint for color finish enameled roofing must be compatible paint of the same formula and color as the specified finish furnished by the manufacturer.

Only use repair and touch-up paint supplied by the roof panel manufacturer and is compatible with the specified system.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the work.. Ensure surfaces are suitable, dry and free of defects and projections which might affect the installation.

Examine primary and secondary roof framing to verify that rafters, purlins, angels, channels, and other structural support members for panels and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer, UL, ASTM, and ASCE/SEI-7-05 and applicable seismic requirements.

Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking; and that installation is within flatness tolerances required by metal roof panel manufacturer.

Examine rough-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of panels prior to installation.

Submit a written report to the Contracting Officer, endorsed by the installer, listing conditions detrimental to the performance of the work. Proceed with installation only after defects have been corrected.

3.2 INSTALLATION

Installation must meet specified requirements and be in accordance with the manufacturer's installation instructions and approved shop drawings. Do not install damaged materials. Dissimilar materials which are not compatible when contacting each other must be insulated by means of gaskets or sealing/insulating compounds. Keep all exposed surfaces and edges clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Remove stained, discolored, or damaged materials from the site.

3.2.1 Preparation

Clean all substrate substances which may be harmful to insulation and roof panels including removing projections capable of interfering with with insulation and roof panel attachment.

Install sub-purlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

3.2.2 Underlayment

Install underlayment according to roof panel manufacturer's written recommendations and recommendation in NRCA "The NRCA Roofing and Waterproofing Manual".

3.2.2.1 Single Layer Felt Underlayment for a Standard Slope Roof Deck

Install single layer of felt underlayment on roof deck perpendicular to roof slope in parallel courses. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses a minimum of 72 inches. Fasten with felt underlayment roofing nails.

Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in a direction to shed water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.

3.2.2.2 Self-Adhering Sheet Underlayment

Install self-adhering sheet underlayment; wrinkle free on roof deck. Comply with low-temperature installation restrictions of manufacturer where applicable. Install at locations indicated on project drawings, lapped in a direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

3.2.2.3 Slip Sheet

Apply specified slip sheet at time of roof panel installation when felt or other underlayment is used that may be in direct contact with and adhere to or adversely impact the underside of roof panels, and as otherwise recommended by the roof panel manufacturer. Install slip sheet over deck substrates prior to roof panel installation.

3.3 INSULATION INSTALLATION

Install insulation concurrently with metal roof panel installation, in thickness indicated, to cover entire roof, according to manufacturer's written instructions.

3.4 PROTECTION OF APPLIED MATERIALS

Do not permit storing, walking, wheeling, and trucking directly on applied roofing/insulation materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to applied roofing/insulation materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.5 FASTENER INSTALLATION

Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions.

3.5.1 Welding

Procedures for manual, shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work must be in accordance with AWS D1.1/D1.1M.

3.6 FLASHING, TRIM, AND CLOSURE INSTALLATION

3.6.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently water tight and weather resistant. Work is to be accomplished to form weather tight construction without waves, warps, buckles, fastening stresses or distortion, and to allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accomplish the work must conform to the manufacturers written instructions.

3.6.2 Metal Flashing

Install exposed metal flashing at building corners, rakes, eaves, junctions between metal siding and roofing, valleys and changes off slope or direction in metal roofing, building expansion joints and gutters.

Exposed metal flashing must be the same material, color, and finish as the specified metal roofing panels. Furnish flashing in minimum 8 foot lengths. Exposed flashing must have 1 inch locked and blind soldered end joints, with expansion joints at intervals of no greater than 16 feet.

Fasten flashing at not more than 8 inches on center for roofs, except where flashing is held in place by the same screws used to secure panels. Exposed flashing and flashing subject to rain penetration must be bedded in specified joint sealant. Flashing which is contact with dissimilar metals must be isolated by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.7 ROOF PANEL INSTALLATION

Provide metal roof panels of full length from eave to ridge or eave to wall as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels or other components of the Work securely in place, with provisions for thermal and structural movement in accordance with NRCA ASMMRM.

Steel Roof Panels: Use stainless steel fasteners for exterior surfaces and galvanized fasteners for unexposed surfaces.

Aluminum Roof Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior and aluminum or galvanized steel fasteners for unexposed surfaces.

Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using approved fasteners according to manufacturer's written instructions. Provide all blocking and nailers as required.

Metal Protection: Where dissimilar metals contact each other or possibly corrosive substrates, protect against galvanic action by coating contact surfaces with a bituminous coating, applying rubberized asphalt underlayment to each contact surface, permanent separation as recommended by the metal roof panel manufacturer.

Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and required for weatherproof performance of metal roof panel system. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

3.7.1 Handling and Erection

Erect roofing system in accordance with the approved erection drawings, printed instructions and safety precautions of the manufacturer.

Do not subject panels to overloading, abuse, or undue impact. Do not apply bent, chipped, or defective panels. Damaged panels must be replaced and removed from the site at the contractors expense. Erect panels true, plumb, and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with indicated rake, eave, and curb overhang. Allow for thermal movement of the roofing, movement of the building structure, and provide permanent freedom from noise due to wind pressure.

Do not permit storage, walking, wheeling or trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards or planks as necessary to avoid damage to the installed roofing materials, and to distribute weight to conform to the indicated live load limits of the roof construction.

Roof panels must be laid with corrugations in the direction of the roof slope. End laps of exterior roofing must not be less than 8 inches; side laps of standard exterior corrugated panels must not be less than 2-1/2 corrugations.

Field cutting of metal roof panels by torch is not permitted. Field cut only as recommended by manufacturer's written instructions.

3.7.2 Closure Strips

Install metal closure strips at open ends of metal ridge rolls; open ends of corrugated or ribbed pattern roofs, and at intersection of wall and roof, unless open ends are concealed with formed eave flashing; rake of metal roof unless open end has a formed flashing member; and in other required areas.

Install closure strips at intersection of the wall with metal roofing; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.7.3 Workmanship

Make lines, arises, and angles sharp and true. Free exposed surfaces from any visible wave, warp, buckle and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and as necessary to make the work watertight.

3.8 ACCEPTANCE PROVISIONS

3.8.1 Erection Tolerances

Erect metal roofing straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions. Horizontal lines must not vary more than 1/8 inch in 40 feet.

3.8.2 Leakage Tests

Finished application of metal roofing is to be subject to inspection and test for leakage by the Contracting Officer or his designated representative, and Architect/Engineer. Inspection and tests will be conducted without cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and removal/replacement of defective materials.

3.8.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials and as recommended by the metal roof panel manufacturer. Finished repaired surfaces must be uniform and free from variations of color and surface texture. Repaired metal surfaces that are not acceptable to the project requirements are to be immediately removed and replaced with new material.

3.8.4 Paint Finished Metal Roofing

Paint finished metal roofing will be tested for color stability by the Contracting Officer during the manufacturer's specified guarantee period. Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government. New panels will be subject to the specified tests for an additional year from the date of their installation.

3.9 CLEAN UP AND DISPOSAL

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or

weld marks, and damage to the finish coating. Touch up scratches in panel finish with manufacturer supplied touch-up paint system to match panel finish. Treat exposed cut edges with manufacturer supplied clear coat.

Collect all scrap/waste materials and place in containers. Promptly dispose of demolished and scrap materials. Do not allow scrap/waste materials to accumulate on-site; transport immediately from the government property and legally dispose of them.

3.10 FIELD QUALITY CONTROL

3.10.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three times, once per week, during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Make inspections during the first 20 squares of roof panel installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections are required for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

Submit three signed copies of the manufacturer's field inspection reports to the Contracting Officer within one week of substantial completion.

3.11 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 1 mm (0.032) inch thick aluminum card for exterior display. Format as directed in paragraph titled "Form One".

Make card 8 1/2 by 11 inches minimum. Information card must identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, roof panel manufacturer and product name, type underlayment(s), date of completion; installing contractor identification and contact information; manufacturer warranty expiration, warranty reference number, and contact information. Install card at interior roof top access point, location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

3.11.1 Form One

FORM 1 - PREFORMED STEEL, ALUMINUM PANEL ROOFING SYSTEM AND COMPONENTS

1. Contract Number:

2. Building Number & Location:

3. NAVFAC Specification Number:

4. Deck/Substrate Type:

5. Slopes of Deck/Roof Structure:

6. Insulation Type & Thickness:

7. Insulation Manufacturer:

8. Vapor Retarder: ( )Yes ( )No

9. Vapor Retarder Type:

10. Preformed Steel Standing Seam Roofing Description:

a. Manufacturer (Name, Address, & Phone No.):
b. Product Name: c. Width: d. Gage:
e. Base Metal: f. Method of Attachment:

11. Repair of Color Coating:

a. Coating Manufacturer (Name, Address & Phone No.):
b. Product Name:
c. Surface Preparation:
d. Recoating Formula:
e. Application Method:

12. Statement of Compliance or Exception:_____
_____
_____

13. Date Roof Completed:

14. Warranty Period: From_____ To_____

15. Roofing Contractor (Name & Address):

16. Prime Contractor (Name & Address):

Contractor's Signature _____ Date:

Textector's Signature _____ Date:

3.12 DATE OF INSTALLATION WALL-MOUNTED PLACARD

For each metal roof panel installation, furnish an exterior "Date of Installation Placard", 0.032 inch thick aluminum, 8-1/2 inches high by 11 inches wide, with mounting accessories, photoengraved to include the following information:

Facility Name and Number
Approximate Roof Area Newly Installed and Date of Completion
Manufacturer, Type of Roof Panel and Name
Underlayment and Insulation System, R value
Installing Contractor and Contact Information
Warranty Expiration Date
Warranty Reference Number and Contact Information

Install placard as directed by the Contracting Officer.

3.13 USACE WARRANTY

CONTRACTOR'S FIVE (5), TEN (10), TWENTY (20) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM

FACILITY DESCRIPTION_____

BUILDING NUMBER:_____

CORPS OF ENGINEERS CONTRACT NUMBER:_____

CONTRACTOR

CONTRACTOR:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

OWNER

OWNER:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONSTRUCTION AGENT

CONSTRUCTION AGENT:_____

ADDRESS:_____

POINT OF CONTACT:_____

TELEPHONE NUMBER:_____

CONTRACTOR'S FIVE (5), TEN (10), TWENTY (20) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

THE NON-STRUCTURAL METAL ROOF SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE NON-STRUCTURAL METAL ROOFING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH UL 580. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHING INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE NON-STRUCTURAL METAL ROOFING SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE NON-STRUCTURAL METAL ROOF SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

_____

(Company President) (Date)

CONTRACTOR'S FIVE (5), TEN (10), TWENTY (20) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOFING SYSTEM
(continued)

THE CONTRACTOR MUST SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE NON-STRUCTURAL METAL ROOFING SYSTEM.SUBMIT ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR IS ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE NON-STRUCTURAL METAL ROOF DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN MUST INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.

6. THIS WARRANTY APPLIES TO THE NON-STRUCTURAL METAL ROOFING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

CONTRACTOR'S FIVE (5), TEN (10), TWENTY (20) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

**REPORTS OF LEAKS AND ROOF SYSTEM DEFICIENCIES MUST BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. INITIATE EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS IMMEDIATELY; SUBMIT A WRITTEN PLAN FOR APPROVAL TO REPAIR OR REPLACE THIS ROOF SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. COMMENCE ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE NON-STRUCTURAL METAL ROOF SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES MUST CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON IS THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., WILL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT MUST PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

POST A FRAMED COPY OF THIS WARRANTY IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

SECTION 07 42 13

METAL WALL PANELS

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA ADM1	(2005; Errata 2005) Aluminum Design Manual
AA ASD1	(2006; Errata 2007) Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2005) Methods of Test for Exterior Walls

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341	(2005; Supp 2001) Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002) Cold-Formed Steel Design Manual Set
AISI/COS/NASPEC	(2001, Supplement 2004) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05	(2006) Minimum Design Loads for Buildings and Other Structures, Including Supplement No. 1

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2003; Errata 2004) Structural Welding Code - Aluminum

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1008/A 1008M	(2007a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 424	(2006) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A 463/A 463M	(2006) Standard Specification for Steel Sheet, Aluminum-Coated
ASTM A 606	(2004) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 755/A 755M	(2003) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 792/A 792M	(2006a) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A 924/A 924M	(2007) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(2007) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 286	(1999; 2004) Standard Terminology Relating to Porcelain Enamel and Ceramic-Metal Systems

ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1308	(2002; R 2007) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(2005) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 2244	(2007) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2002) Measuring Adhesion by Tape Test
ASTM D 3363	(2005) Film Hardness by Pencil Test
ASTM D 4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4587	(2005) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Standard Test Method for Specular Gloss
ASTM D 5894	(2005) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610	(2007) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	(2002e1) Evaluating Degree of Blistering of Paints
ASTM D 822	(2001; R 2006) Filtered Open-Flame

	Carbon-Arc Exposures of Paint and Related Coatings
ASTM D 968	(2005e1) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 1592	(2005) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2002) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI 1001	(1996) Specification for Architectural Porcelain Enamel (ALS-100)
PEI CG-3	(2005) Color Guide for Architectural Porcelain Enamel

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2006) Architectural Sheet Metal Manual, Sixth Edition, Second Printing

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 12	(1982; E 2000) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-P-28578	(Rev B; CANC Notice 1) Paint, Water-Borne,

	Acrylic or Modified Acrylic, Semi-Gloss, for Metal Surfaces

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006) Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	(2007) Building Materials Directory

1.2 DEFINITIONS

Metal Wall Panel: Metal wall panels, attachment system components and accessories necessary for a complete weather-tight wall system.

1.3 DESCRIPTION OF WALL PANEL SYSTEM

Factory color finished, Mill finish, galvanized, galvalume, aluminum, metal wall panel system with concealed fastening, exposed fastener attachment. Panel profile must be embossed, recessed seam lock, flush face, smooth face, recessed bead, raised bead, striated, square ribbed, beaded rib, roll lock seam, snap lock seam, box rib, corrugated, standing seam, batten seam, and with stiffening ribs in the flat of the panel, as shown on drawings.

1.3.1 Metal Wall Panel General Performance

Comply with performance requirements, conforming to AISI/COS/NASPEC, without failure due to defective manufacture, fabrication, installation, or other defects in construction. Wall panels and accessory components must conform to the following standards:

ASTM A 1008/A 1008M
ASTM A 123/A 123M
ASTM A 36/A 36M
ASTM A 424, ASTM C 286, PEI 1001, PEI CG-3 for Porcelain and Ceramic Enameling
ASTM A 653/A 653M
ASTM A 463/A 463M for aluminum coated steel sheet
ASTM A 606
ASTM A 755/A 755M for metallic coated steel sheet for exterior coil pre-painted applications.
ASTM A 780 for repair of damage or uncoated areas of hot-dipped galvanized coating.
ASTM A 924/A 924M for metallic coated steel sheet
ASTM D 522 for applied coatings
UL Bld Mat Dir

1.3.2 Structural Performance

Maximum calculated fiber stress must not exceed the allowable value in the AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads is limited to L/180. Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Contractor must provide design for members and connections not shown on the drawings. Siding panels and accessories must be the products of the same manufacturer.

Provide metal wall panel assemblies complying with the load and stress requirements in accordance with ASTM E 1592. Wind Load force due to wind

action governs the design for panels.

Wall systems and attachments are to resist the wind loads as determined by UL 580 and ASCE/SEI 7-05 in the geographic area where the construction will take place, in pounds per square foot. Submit five copies of wind load tests and seismic tests to the Contracting Officer.

Provide metal wall panel assembly for seismic conditions complying with the applicable requirements of AISC 341.

1.3.3 Air Infiltration

Air leakage must conform to the limits through the wall assembly area when tested according to ASTM E 283.

1.3.4 Water Penetration Under Static Pressure

No water penetration when tested according to ASTM E 331.

1.3.5 Water Penetration Under Dynamic Pressure

No evidence of water leakage when tested according to AAMA 501.1.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Documentation for the following items:

Qualification of Manufacturer
Qualification of Installer
Qualification of Welders
Sample Warranty

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Submit Manufacturer's data indicating percentage of recycle material in wall panels to verify sustainable acquisition compliance.

Submit Manufacturer's catalog data for the following items:

Factory Color Finish
Closure Materials
Pressure Sensitive Tape
Sealants and Caulking
Galvanizing Repair Paint
Enamel Repair Paint
Aluminized Steel Repair Paint
Accessories

SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width
Fasteners
Metal Closure Strips, 10 inches long of each type

Submit manufacturer's color charts and chips, approximately 4 by 4 inches, showing full range of colors, textures and patterns available for wall panels with factory applied finishes.

SD-05 Design Data

As applicable, submit the following wind load design analysis data, to include, but not limited to:

wind speed
exposure category,co-efficient,importance factor
type of facility
negative pressures for each zone
methods and requirements of attachment

SD-06 Test Reports

Submit test reports for the following in accordance with the referenced articles in this section.

Leakage Tests
Wind Load Tests
Coatings and Base Metal Tests
Chalking Tests
Seismic Tests

SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Coil Stock
Fasteners
Galvanizing Repair Paint
Enamel Repair Paint

SD-08 Manufacturer's Instructions

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications.

Installation of Wall panels

SD-09 Manufacturer's Field Reports

Submit _____ bound copies of the Manufacturer's Field Reports

SD-11 Closeout Submittals

Warranty
Maintenance Instructions

20 year "No Dollar Limit" warranty for labor and material

1.5 QUALITY ASSURANCE

1.5.1 Pre-Installation Conference

Upon notification of submittal receipt and approval by the Contracting Officer; and prior to the commencement of the work, the Contractor must attend a pre-installation conference to review the following:

a. Drawings and Specifications.

b. Qualification of Installer, Qualification of Welders

c. sustainable acquisition

d. Sample Warranty

e. Sample wall panels, 12 inches long by actual panel width

f. Sample metal closure strips, 10 inches long of each type

g. Color charts and chips

h. Coatings and base metal tests, chalking tests

i. Construction schedule, availability of materials, Installer's personnel, equipment and facilities required to progress with the work without delay.

j. Methods and procedures related to installation of wall panels, including manufacturer's written instructions. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

k. Support conditions for compliance with requirements, including alignment between and attachment to structural members.

l. Flashing, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.

m. Governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

n. Temporary protection requirements for metal wall panel assembly during and after installation.

o. Wall panel observation and repair procedures after metal wall panel installation. Provide detailed written instructions including copies of Material Safety Data Sheets for maintenance and repair materials, and manufacturer's maintenance instructions.

1.5.1.1 Installation Drawings

Installation shop drawings for wall panels, flashing, accessories, and anchorage systems must indicate completely dimensioned structural frame and erection layouts, openings in the wall, special framing details, and construction details at corners, building intersections and flashing, location and type of mastic and metal filler strips.

1.5.1.2 Wind Load Design Analysis

Wind design analysis must include wall plan delineating dimensions and attachment patterns for each zone. Wind design analysis must be prepared and sealed by Licensed Project Engineer in the geographic area where the construction will take place.

1.5.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and installations in the geographical area where construction will take place.

1.5.3 Qualification of Manufacturer

Certify that metal wall panel system manufacturer has a minimum of five (5) years experience in manufacturing metal wall system and accessory products.

Manufacturer must also provide engineering services by an authorized engineer; currently licensed in the geographical area where construction will take place, having a minimum of four (4) years experience as an engineer knowledgeable in wind load design analysis, protocols and procedures per MBMA MBSM, "Metal Building Systems Manual"; ASCE/SEI 7-05, and ASTM E 1592 and seismic design conforming to AISC 341.

Provide certified engineering calculations, using the products submitted, for Wind load requirements in accordance with ASCE/SEI 7-05.

1.5.3.1 Manufacturer's Certificates

Also provide the following certifications from the manufacturer:

Coil Stock
Fasteners
Galvanizing Repair Paint
Enamel Repair Paint

Submit certification from coil stock manufacturer or supplier that the machinery used will form the provided coil stock without warping, waviness, or rippling that is not a part of the panel profile, and without damage, abrasion or marring of the finish coating.

Provide evidence that products used within this specification are manufactured in the United States.

1.5.4 Certified Qualification of Installation Contractor

The installation contractor must be approved and certified by the metal wall panel manufacturer prior to beginning the installation of the metal wall panel system. Subcontracting by Certified Contractor for the metal wall panel work is not permitted.

1.5.4.1 Qualifications for Welding Work

Welding procedures must conform to AWS A5.1/A5.1M, AWS D1.1/D1.1Mfor steel or AWS D1.2/D1.2M for aluminum.

1.5.5 Single Source

Obtain each type of metal wall panels, clips, closure materials and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.6 DELIVERY, HANDLING, AND STORAGE

Deliver and protect package components, sheets, metal wall panels, and other manufactured items to prevent damage or deformation during transportation and handling.

Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

Stack and store metal wall panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

Retain strippable protective covering on metal wall panel until actual installation.

1.7 PROJECT CONDITIONS

1.7.1 Field Measurements

Verify locations of wall framing and opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.7.2 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into wall system or building.

1.8 WARRANTY

Warranty must conform to the Sample Warranty as reviewed and approved by the Contracting Officer at the Pre-Installation Conference.

1.8.1 20 Year 'No Dollar Limit Warranty for Labor and Material

Furnish manufacturer's no-dollar-limit warranty for the metal wall panel system. The warranty period is to be no less than twenty (20) years from the date of Government acceptance of the work. The warranty is to be issued directly to the Government. The warranty is to provide that if within the warranty period the metal wall panel system shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal wall panel system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal wall panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 FABRICATION

Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Fabricate metal wall panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

2.1.1 Sheet Metal Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: fabricate nonmoving end seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA 1793 or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

2.2 PANEL MATERIALS

2.2.1 Aluminum Sheet

Roll-form aluminum wall panels to the specified profile, with fy =30, 40, 50, 80 ksi, .032", .040", .050" thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Aluminum Sheet conforming to ASTM B 209, AA ASD1 and AA ADM1.

b. Individual panels must be have continuous length to cover the entire length of any wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

i. Profile and coverage to be a minimum height and width from manufacturer's standard for the indicated wall area.

ii. Profile to be a 1-1/2 inch high rib at 12 inches o.c. with small stiffening ribs, 38 inch overall width with 36 inch coverage and exposed fasteners.

iii. Profile to be a 1-1/2 inch high rib at 7.2 inches o.c., 38-7/8 inch overall width with 36 inch coverage and exposed fasteners.

iv. Profile to be a 1 inch high rib at 4 inches o.c., 49-5/8 inch overall width with 48, 44 inch coverage and exposed fasteners.

v. Profile to be a 1 inch high rib at 8 inches o.c., 41-5/8 inch overall width with 40 inch coverage and exposed fasteners.

vi. Profile to be a 1-3/4 inch high V-beam rib at 5 inches o.c., 44-7/8 inch overall width with 42 inch coverage and exposed fasteners.

vii. Profile to be a 7/8 inch high corrugated rib at 2 inches o.c., 38-7/8 inch overall width with 36 inch coverage and exposed fasteners.

viii. Profile to be a 3 inch high standing seam, 24 inch coverage, factory-caulked and mechanical crimping or snap-together seams with concealed clips and fasteners.

ix. Profile to be a 1, 1-3/4, 2, 2-1/2 inch high standing seam, 12, 16, 18 inch coverage, with mechanical crimping or snap-together seams with concealed clips and fasteners.

x. Smooth, flat, Embossed surface texture.

2.2.2 Steel Sheet

Roll-form steel wall panels to the specified profile, with fy = 30, 40, 50, 80 ksi, 26, 24, 22, 20, 18 gauge and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Galvanized Steel Sheet conforming to ASTM A 653/A 653M and AISI SG03-3.

b. Aluminum-Zinc Alloy-coated Steel Sheet conforming to ASTM A 792/A 792M and AISI SG03-3.

c. Individual panels must be continuous length to cover the entire length of any unbroken wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

d. Provide panels with thermal expansion and contraction consistent with the type of system specified.

i. Profile and coverage to be a minimum height and width from manufacturer's standard for the indicated wall area.

ii. Profile to be a 1-1/2 inch high rib at 12 inches o.c. with small stiffening ribs, 38 inch overall width with 36 inch coverage and exposed fasteners.

iii. Profile to be a 1-1/2 inch high rib at 7.2 inches o.c., 38-7/8 inch overall width with 36 inch coverage and exposed fasteners.

iv. Profile to be a 1 inch high rib at 4 inches o.c., 49-5/8 inch overall width with 48, 44 inchcoverage and exposed fasteners.

v. Profile to be a 1 inch high rib at 8 inches o.c., 41-5/8 inch overall width with 40 inch coverage and exposed fasteners.

vi. Profile to be a 7/8 inch high corrugated rib at 2 inches o.c., 38-7/8 inch overall width with 36 inch coverage and exposed fasteners.

vii. Profile to be a 3 inch high standing seam, 24 inch coverage, factory-caulked and mechanical crimping or snap-together seams with concealed clips and fasteners.

viii. Profile to be a 1, 1-3/4, 2, 2-1/2 inch high standing seam, 12, 16, 18 inch coverage, with mechanical crimping or snap-together seams with concealed clips and fasteners.

ix. Smooth, flat, Embossed Surface Texture.

2.2.3 Factory Color Finish

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes. Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

All panels are to receive a factory-applied polyvinylidene fluoride, Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

2.2.3.1 Metal Preparation

Carefully prepare all metal surface for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

2.2.3.2 Prime Coating

Apply a base coat of epoxy paint, specifically formulated to interact with the top-coat, to the prepared surfaces by roll coating to a dry film thickness of 0.20 + 0.05 mils. Prime coat must be oven cured prior to application of finish coat.

2.2.3.3 Exterior Finish Coating

Roll coat the finish coating over the primer by roll coating to dry film thickness of 0.80 + 5 mils (3.80 + 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 + 0.10 mils (4.00 + 0.10 mils for Vinyl

Plastisol). Oven-cure finish coat.

2.2.3.4 Interior Finish Coating

Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 + 0.05 mils for a total dry film thickness of 0.50 + 0.10 mils. Oven-cured the wash coat.

2.2.3.5 Color

Provide exterior finish color as selected by the Contracting Officer from the manufacturer's standard color chart, as specified.

2.2.3.6 Physical Properties

Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General: SSPC Paint 12, MIL-P-28578, ASTM D 5894, and ASTM D 4587.
Abrasion: ASTM D 968
Adhesion: ASTM D 3359
Chalking: ASTM D 4214
Chemical Pollution: ASTM D 1308
Color Change and Conformity: ASTM D 2244
Creepage: ASTM D 1654
Cyclic Corrosion Test: ASTM D 5894
Flame Spread: ASTM E 84
Flexibility: ASTM D 522
Formability: ASTM D 522
Gloss at 60 and 85 degrees: ASTM D 523
Humidity: ASTM D 2247 and ASTM D 714
Oxidation: ASTM D 610
Pencil Hardness: ASTM D 3363
Reverse Impact: ASTM D 2794
Salt Spray: ASTM B 117
Weatherometer: ASTM G 23 and ASTM D 822

2.3 MISCELLANEOUS METAL FRAMING

Cold-formed metallic-coated steel sheet conforming to ASTM A 653/A 653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless other wise indicated.

2.3.1 Fasteners for Miscellaneous Metal Framing

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to supporting members and substrates in accordance with the wall panel manufacturer's and ASCE/SEI 7-05 requirements.

2.4 FASTENERS

2.4.1 General

2.4.1.1 Exposed Fasteners

Provide corrosion resistant fasteners for wall panels, made of coated steel, aluminum, 300 - series corrosion resisting stainless steel, 305 -

series corrosion resisting stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads.

Fasteners for accessories must be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 inch thick.

2.4.1.2 Hidden Fasteners

Provide corrosion resistant fasteners recommended by the manufacturer to meet the performance requirements and design loads.

2.4.1.3 Screws

Screws to be corrosion resistant coated steel, aluminum and/or 300 - series, 305 - series stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.4.1.4 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.4.1.5 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A 653/A 653M, Z275 G 90 or Series 300 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.5 ACCESSORIES

2.5.1 General

All accessories must be compatible with the metal wall panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the wall panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips must be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.5.2 Rubber Closure Strips

Provide closed-cell, expanded cellular rubber conforming to ASTM D 1056 and ASTM D 1667; extruded or molded to the configuration of the specified wall panel and in lengths supplied by the wall panel manufacturer.

2.5.3 Metal Closure Strips

Provide factory fabricated aluminum, steel, closure strips to be the same gauge, thickness, color, finish and profile of the specified wall panel.

2.5.4 Joint Sealants

2.5.4.1 Sealants and Caulking

Provide approved gun type sealants for use in hand- or air-pressure calking guns at temperatures above 40 degrees F 4 degrees C (or frost-free application at temperatures above 10 degrees F minus 12 degrees C) with minimum solid content of 85 percent of the total volume. Sealants must dry with a tough, durable surface skin which permit remaining soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints receiving sealants with a compatible one-component or two-component primer as recommended by the wall panel manufacturer.

2.5.4.2 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C 920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.5.4.3 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C 920, Type II. Color to match panel colors.

2.5.4.4 Pressure Sensitive Tape

Provide pressure sensitive tape sealant, 100% solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the wall panel manufacturer.

2.6 SHEET METAL FLASHING AND TRIM

2.6.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.7 REPAIR OF FINISH PROTECTION

Repair paint for color finish enameled wall panel must be compatible paint of the same formula and color as the specified finish furnished by the wall panel manufacturer. Provide ____ pints, quarts of aluminized steel repair paint, repair paint matching the specified wall panels.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of the Work.

Examine primary and secondary wall framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal wall panel manufacturer, UL, ASTM, ASCE/SEI 7-05 and as required for the geographical area where construction will take place.

Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Installer, listing conditions detrimental to performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment. Miscellaneous framing installation, including sub-purlins, girts, angles, furring, and other miscellaneous wall panel support members and anchorage must be according to metal wall panel manufacturer's written instructions.

3.3 WALL PANEL INSTALLATION

Provide full length metal wall panels, from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Bent, chipped, or defective sheets shall not be applied.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

3.3.1 Steel Wall Panels

Use stainless-steel fasteners for exterior surfaces and galvanized steel fasteners for interior surfaces.

3.3.2 Aluminum Wall Panels

Use aluminum or stainless-steel fasteners for exterior surfaces and aluminum or galvanized steel fasteners for interior surfaces.

3.3.3 Anchor Clips

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.3.4 Metal Protection

Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

3.3.5 Joint Sealers

Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

3.4 FASTENER INSTALLATION

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.5 FLASHING, TRIM AND CLOSURE INSTALLATION

3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams to form permanently watertight and weather resistant.

Install sheet metal work is to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.5.2 Metal Flashing

Install exposed metal flashing at building corners, sills and eaves, junctions between metal siding and walling. Exposed metal flashing must be the same material, color, and finish as the specified metal wall panel.

Fasten flashing at a minimum of 8 inches on center, except where flashing

is held in place by the same screws that secure covering sheets.

Flashing is to be furnished in at least 8 foot lengths. Exposed flashing is to have 1 inch locked and blind-soldered end joints, and expansion joints at intervals of not more than 16 feet.

Exposed flashing and flashing subject to rain penetration to be bedded in the specified joint sealant.

Isolate flashing which is in contact with dissimilar metals by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.5.3 Closures

Install metal closure strips at open ends of corrugated or ribbed pattern walls, and at intersection of wall and wall unless open ends are concealed with formed eave flashing; and in other required areas.

Install mastic closure strips at intersection of the wall with metal walling; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.6 WORKMANSHIP

Make lines, arises, and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight.

3.7 ACCEPTANCE PROVISIONS

3.7.1 Erection Tolerances

Erect metal wall panels straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions.

3.7.2 Leakage Tests

Finished application of metal wall panels are to be subject to inspection and test for leakage by request of the Contracting Officer, Architect/Engineer. Conduct inspection and tests at no cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and the removal and replacement of defective materials.

3.7.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials. Finished repaired surfaces must be uniform and free from variations of color and surface texture.

Repaired metal surfaces that are not acceptable to the project requirements and/or Contracting Officer are to be immediately removed and replaced with new material.

3.7.4 Paint-Finish Metal Siding

Paint-finish metal siding will be tested for color stability by the Contracting Officer during the manufacturer's specified guarantee period.

Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government.

New panels will be subject to the specified tests for an additional year from the date of their installation.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

Make visual inspections as necessary to ensure compliance with specified requirements. Additionally, verify the following:

a. Materials comply with the specified requirements.

b. All materials are properly stored, handled and protected from damage. Damaged materials are removed from the site.

c. Framing and substrates are in acceptable condition, in compliance with specification, prior to application of wall panels.

d. Panels are installed without buckles, ripples, or waves and in uniform alignment and modulus.

e. Side laps are formed, sealed, fastened or seam locked as required.

f. The proper number, type, and spacing of attachment clips and fasteners are installed.

g. Installer adheres to specified and detailed application parameters.

h. Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Provide five bound copies of Manufacturer's Field Reports to the Contracting Officer two weeks prior to project close-out.

3.9 CLEAN-UP AND DISPOSAL

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove

grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

Collect and place scrap/waste materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site; transport demolished materials from government property and legally dispose of them.

-- End of Section --

SECTION 07 42 63

FABRICATED WALL PANEL ASSEMBLIES

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA ADM1	(2005; Errata 2005) Aluminum Design Manual
AA ASD1	(2006; Errata 2007) Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2005) Methods of Test for Exterior Walls

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341	(2005; Supp 2001) Seismic Provisions for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002) Cold-Formed Steel Design Manual Set
AISI/COS/NASPEC	(2001, Supplement 2004) North American Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05	(2006) Minimum Design Loads for Buildings and Other Structures, Including Supplement No. 1

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2003; Errata 2004) Structural Welding Code - Aluminum

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1008/A 1008M	(2007a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 424	(2006) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A 463/A 463M	(2006) Standard Specification for Steel Sheet, Aluminum-Coated
ASTM A 606	(2004) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 755/A 755M	(2003) Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 792/A 792M	(2006a) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A 924/A 924M	(2007) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(2007) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 273/C 273M	(2007a) Shear Properties of Sandwich Core Materials
ASTM C 286	(1999; 2004) Standard Terminology Relating

	to Porcelain Enamel and Ceramic-Metal Systems
ASTM C 553	(2002) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 612	(2004) Mineral Fiber Block and Board Thermal Insulation
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1308	(2002; R 2007) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1621	(2004a) Compressive Properties of Rigid Cellular Plastics
ASTM D 1622	(2003) Apparent Density of Rigid Cellular Plastics
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 2244	(2007) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794	(1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 2856	(1994; R 1998) Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer
ASTM D 3363	(2005) Film Hardness by Pencil Test
ASTM D 4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523	(1989; R 1999) Standard Test Method for Specular Gloss
ASTM D 714	(2002e1) Evaluating Degree of Blistering of Paints

ASTM D 822	(2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D 968	(2005e1) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 119	(2007a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 136	(2004) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 1592	(2005) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2002) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI 1001	(1996) Specification for Architectural Porcelain Enamel (ALS-100)
PEI CG-3	(2005) Color Guide for Architectural Porcelain Enamel

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2006) Architectural Sheet Metal Manual, Sixth Edition, Second Printing

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006) Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	(2007) Building Materials Directory

1.2 DEFINITIONS

Fabricated Wall Panel Assembly: Metal wall and liner panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories shop fabricated or field assembled for a complete weather-tight wall system.

1.3 DESCRIPTION OF FABRICATED WALL PANEL ASSEMBLY SYSTEM

Factory color finished, Mill finish, galvanized, galvalume, aluminum, metal wall panel system with concealed fastening, exposed fastener, attachment. Panel profile must be embossed, recessed seam lock, flush face, smooth face, recessed bead, raised bead, striated, square ribbed, beaded rib, roll lock seam, snap lock seam, box rib, corrugated, standing seam, batten seam, and with stiffening ribs in the flat of the panel, as shown on drawings. Interior finish of panel assembly to be _____.

1.3.1 Metal Wall Panel General Performance

Comply with performance requirements, conforming to AISI/COS/NASPEC, without failure due to defective manufacture, fabrication, installation, or other defects in construction. Wall panels and accessory components must conform to the following standards:

ASTM A 1008/A 1008M
ASTM A 123/A 123M
ASTM A 36/A 36M
ASTM A 424, ASTM C 286, PEI 1001, PEI CG-3 for Porcelain and Ceramic Enameling
ASTM A 653/A 653M
ASTM A 463/A 463M for aluminum coated steel sheet
ASTM A 606
ASTM A 755/A 755M for metallic coated steel sheet for exterior coil pre-painted applications.
ASTM A 780 for repair of damage or uncoated areas of hot-dipped galvanized coating.
ASTM A 924/A 924M for metallic coated steel sheet
ASTM C 273/C 273M
ASTM D 522 for applied coatings
UL Bld Mat Dir

1.3.2 Structural Performance

Maximum calculated fiber stress must not exceed the allowable value in the AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads is limited to L/180. Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Contractor must provide design for members and connections not shown on the drawings. Siding panels and accessories must be the products of the same manufacturer.

Provide metal wall panel assemblies complying with the load and stress

requirements in accordance with ASTM E 1592. Wind Load force due to wind action governs the design for panels.

Wall systems and attachments are to resist the wind loads as determined by UL 580 and ASCE/SEI 7-05 in the geographic area where the construction will take place, in pounds per square foot. Submit five copies of wind load tests and seismic tests to the Contracting Officer.

Provide metal wall panel assembly for seismic conditions complying with the applicable requirements of AISC 341.

1.3.3 Air Infiltration

Air leakage must conform to the limits through the wall assembly area when tested according to ASTM E 283.

1.3.4 Water Penetration Under Static Pressure

No water penetration when tested according to ASTM E 331.

1.3.5 Water Penetration Under Dynamic Pressure

No evidence of water leakage when tested according to AAMA 501.1.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualification of Manufacturer
Qualification of Installer
Qualifications for Welding Work

SD-02 Shop Drawings

Fabrication and Installation drawings for the following items are to indicate completely dimensioned structural frame and erection layouts, openings in the wall, special framing details, and construction details at corners, building intersections and flashing, location and type of mastic and metal filler strips.

Wall Panel Assemblies
Flashing and Accessories
Anchorage Systems

SD-03 Product Data

Submit Manufacturer's data indicating percentage of recycle material in wall panels to verify sustainable acquisition compliance.

Submit Manufacturer's catalog data for the following items:

Factory Color Finish
Sub-girts and Formed Shapes
Closure Materials
Insulation

Pressure Sensitive Tape
Sealants and Caulking
Rated Wall Assembly
Galvanizing Repair Paint
Enamel Repair Paint
Aluminized Steel Repair Paint
Accessories

SD-04 Samples

Submit as required each of the following samples:

Wall Panel Assemblies, 12 inches long by actual panel width
Fasteners
Metal Closure Strips, 10 inches long of each type
Insulation, approximately 8 by 11 inches

Submit manufacturer's color charts and chips, approximately 4 by 4 inches, showing full range of colors, textures and patterns available for wall panels with factory applied finishes.

SD-05 Design Data

wind design analysis

SD-06 Test Reports

Submit test reports for the following in accordance with the referenced articles in this section.

Leakage Tests
wind load tests
seismic tests

Coatings and base metals of metal wall type of test as specified in paragraphs entitled, "Steel Sheet Materials," and in various referenced standards in this section.

Factory Color Finish Performance Requirements

SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Fasteners
Galvanizing Repair Paint
Enamel Repair Paint

Provide evidence that products used within this specification are manufactured in the United States.

Qualification of Manufacturer

Certify that the manufacturer of the metal wall panel system meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Installer

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Installation Contractor."

Submit the wall system assembly wind load and fire rating classification listings.

SD-08 Manufacturer's Instructions

Installation of Wall panels

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

SD-11 Closeout Submittals

Warranty
Instructions To:
Government and/or Contractor Personnel
Include copies of Material Safety Data Sheets for maintenance/repair materials.

Submit 20 year "No-Dollar-Limit" warranty for labor and materials.

1.5 QUALITY ASSURANCE

1.5.1 Pre-Installation Conference

After submittals are received and approved but before wall panel and insulation work, including associated work, is performed, the Contracting Officer will hold a pre-siding conference to review the following:

a. The drawings, including Fabrication and Installation drawings,showing complete Wall Panel Assemblies, and specifications.
Include details for the following for review:

flashing and accessories
anchorage systems
manufacturer's catalog data
Factory Color Finish

Submit manufacturer's color charts and chips, approximately 4 by 4 inches, showing full range of colors, textures and patterns available for wall panels with factory applied finishes.

Sub-girts and Formed Shapes
Closure Materials, including metal closure strips.
Insulation
Pressure Sensitive Tape
Rated Wall Assembly test data
Accessories
Fasteners

b. Finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

c. Methods and procedures related to metal wall panel installation, including manufacturer's written instructions for Installation of Wall panels, and veriication of wall system assembly wind load and fire rating classification listings.

d. Support conditions for compliance with requirements, including alignment between and attachment to structural members. Provide details of wind design analysis including wind speed, exposure category, co-efficient, importance factor, designates type of facility, negative pressures for each zone, methods and requirements of attachment. Wind design analysis to include wall plan delineating dimensions and attachment patterns for each zone. Wind design analysis to be prepared and sealed by Licensed Project Engineer in the geographic area where the construction will take place.

e. Flashing, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.

f. Governing regulations and requirements for insurance, certificates, tests and inspections if applicable. Include certification for sustainable acquisition and wall system assembly wind load and fire rating classification. Safety plan review must include applicable Material Safety Data Sheets.

g. Temporary protection requirements for metal wall panel assembly during and after installation.

h. Wall panel observation and repair procedures after metal wall panel installation. Include review of sample Galvanizing Repair Paint, Enamel Repair Paint, Aluminized Steel Repair Paint.

i. Sample 20 year "No-Dollar-Limit" warranty, Warranty.

1.5.2 Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and installations in the geographical area where construction will take place.

1.5.3 Qualification of Manufacturer

Metal wall panel system manufacturer must have:

a. A minimum of five (5) years experience in manufacturing metal wall system and accessory products.

b. Provide engineering services by an authorized engineer; currently licensed in the geographical area where construction will take place, having a minimum of four (4) years experience as an engineer knowledgeable in wind load design analysis, protocols and procedures for the MBMA MBSM; ASCE/SEI 7-05, and ASTM E 1592.

Provide certified engineering calculations using the products submitted for:

Wind load requirements in accordance with FM Wind Design Guide and ASCE/SEI 7-05.

1.5.4 Qualification of Installer

The installation contractor must be approved and certified by the wall panel manufacturer prior to beginning the installation of the metal wall system.

1.5.4.1 Qualifications for Welding Work

Welding procedures must conform to AWS A5.1/A5.1M, AWS D1.1/D1.1M for steel or AWS D1.2/D1.2M for aluminum.

1.5.5 Single Source

Obtain each type of metal wall and liner panels, clips, closures and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.5.6 Surface-Burning Characteristics

Provide metal wall panels having insulation core material with the following surface-burning characteristics as determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

1.5.7 Fire-Resistance Ratings

Where indicated, provide metal wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
Combustion Characteristics: ASTM E 136.

1.5.8 Fabrication

Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

Fabricate metal wall panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

1.5.8.1 Sheet Metal Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

1.5.9 Finishes

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes.

Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.6 DELIVERY, HANDLING, AND STORAGE

Deliver and package components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed and protected during transportation and handling.

Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

Stack and store metal wall panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

Retain strippable protective covering on metal wall panel for period of metal wall panel installation.

Protect foam-plastic insulation as follows:

a. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

b. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.

Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 PROJECT CONDITIONS

Weather Limitations: Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing walling system or building.

Field Measurements: Verify locations of wall framing and opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

Furnish manufacturer's no-dollar-limit warranty for the metal wall panel system. The warranty period is to be no less than twenty (20) years from the date of Government acceptance of the work. The warranty is to be issued directly to the Government. The warranty is to provide that if within the warranty period the metal wall panel system shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the wall panel system resulting from defective materials and correction of the defective workmanship is to be the responsibility of the metal wall panel system manufacturer. Repairs that become necessary because of defective materials and workmanship while metal wall panel system is under warranty are to be performed within 24 hours after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within 24 hours of notification will constitute grounds for having emergency repairs performed by others and not void the warranty.

PART 2 PRODUCTS

2.1 PANEL MATERIALS

2.1.1 Aluminum Sheet

Roll-form aluminum wall and liner panels to the specified profile, with fy = .032, .040, .050 thickness and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Aluminum Sheet conforming to ASTM B 209, AA ASD1 and AA ADM1.

b. Individual panels to have continuous length to cover the entire length of any wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

1. Profile and coverage to be a minimum height and width from manufacturer s standard for the indicated wall area.

2. Profile to be a 1-1/2 inch high rib at 12 inches o.c. with small stiffening ribs, 38 inch overall width with 36 inch coverage and exposed fasteners.

3. Profile to be a 1-1/2 inch high rib at 7.2 inches o.c., 38-7/8 inch overall width with 36 inch coverage and exposed fasteners.

4. Profile to be a 1 inch high rib at 4 inches o.c., 49-5/8 inch overall width with 48, 44 inch coverage and exposed fasteners.

5. Profile to be a 1 inch high rib at 8 inches o.c., 41-5/8 inch overall width with 40 inch coverage and exposed fasteners.

6. Profile to be a 1-3/4 inch high V-beam rib at 5 inches o.c., 44-7/8 inch overall width with 42 inch coverage and exposed fasteners.

7. Profile to be a 7/8 inch high corrugated rib at 2 inches o.c., 38-7/8 inch overall width with 36 inch coverage and exposed fasteners.

8. Profile to be a 3 inch high standing seam, 24 inch coverage, factory-caulked and mechanical crimping or snap-together seams with concealed clips and fasteners.

9. Profile to be a 1, 1-3/4, 2, 2-1/2 inch high standing seam, 12, 16, 18 inch coverage, with mechanical crimping or snap-together seams with concealed clips and fasteners.

10. Smooth, flat Embossed, surface texture.

2.1.2 Steel Sheet

Roll-form steel wall and liner panels to the specified profile, with fy = , 26, 24, 22, 20, 18 gauge and depth as indicated. Material must be plumb and true, and within the tolerances listed:

1. Galvanized Steel Sheet conforming to ASTM A 653/A 653M and AISI SG03-3.

2. Aluminum-Zinc Alloy-coated Steel Sheet conforming to ASTM A 792/A 792M and AISI SG03-3.

3. Individual panels to have continuous length to cover the entire length of any unbroken wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

4. Provide panels with thermal expansion and contraction consistent with the type of system specified.

a. Profile and coverage to be a minimum height and width from manufacturer's standard for the indicated wall area.

b. Profile to be a 1-1/2 inch high rib at 12 inches o.c. with small stiffening ribs, 38 inch overall width with 36 inch coverage and exposed fasteners.

c. Profile to be a 1-1/2 inch high rib at 7.2 inches o.c., 38-7/8 inch overall width with 36 inch coverage and exposed fasteners.

d. Profile to be a 1 inch high rib at 4 inches o.c., 49-5/8 inch overall width with 48, 44 inch coverage and exposed fasteners.

e. Profile to be a 1 inch high rib at 8 inches o.c., 41-5/8 inch overall width with 40 inch coverage and exposed fasteners.

f. Profile to be a 7/8 inch high corrugated rib at 2 inches o.c.,

38-7/8 inch overall width with 36 inch coverage and exposed fasteners.

g. Profile to be a 3 inch high standing seam, 24 inch coverage, factory-caulked and mechanical crimping or snap-together seams with concealed clips and fasteners.

h. Profile to be a 1, 1-3/4, 2, 2-1/2 inch high standing seam, 12, 16, 18 inch coverage, with mechanical crimping or snap-together seams with concealed clips and fasteners.

i. Smooth, flat Embossed, surface texture.

2.1.3 Foam-Insulation Core Wall Panel

Provide factory-formed aluminum, steel, wall panel assembly fabricated from two sheets of metal with modified polyisocyanurate or polyurethane foam insulation core foamed-in-place, board during fabrication with joints between panels designed to form weather-tight seals. Include accessories required for weather-tight installation.

a. Closed-Cell Content: 90 percent when tested according to ASTM D 2856.

b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D 1622.

c. Compressive Strength: Minimum 20 psi (140 kPa) when tested according to ASTM D 1621.

d. Shear Strength: 26 psi (179 kPa) when tested according to ASTM C 273/C 273M.

2.1.4 Insulated Panel Construction

Shop fabricate or field assemble insulated panel construction with specified exterior and interior aluminum, steel sheet in accordance with manufacturer's printed instructions.

Insulation to be glass-fiber, slag-wool-fiber, rock-wool-fiber, conforming to ASTM C 553 and ASTM C 612 of thickness and density as required for the geographical area where construction will take place. Glass-Fiber and Mineral-Wool-Fiber are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/).

Insulation fasteners to be adhesively attached, plate welded to projecting spindle anchors; capable of holding insulation of thickness indicated, secured in position with self-locking washer and complying with the following requirements:

a. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

b. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

c. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

d. Anchor adhesive to be a product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

2.1.5 Finish

All panels are to receive a factory-applied polyvinylidene fluoride, Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

a. Metal Preparation: All metal is to have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

b. Prime Coating: A base coat of epoxy paint, specifically formulated to interact with the top-coat, is to be applied to the prepared surfaces by roll coating to a dry film thickness of 0.20 + 0.05 mils. This prime coat must be oven cured prior to application of finish coat.

c. Exterior Finish Coating: Apply the finish coating over the primer by roll coating to dry film thickness of 0.80 + 5 mils (3.80 + 0.50 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 + 0.10 mils (4.00 + 0.10 mils for Vinyl Plastisol). This finish coat must be oven-cured.

d. Interior Finish Coating: Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 + 0.05 mils for a total dry film thickness of 0.50 + 0.10 mils. The wash-coat must be oven-cured.

e. Color: The exterior finish chosen from the manufacturer's standard color chart.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

Chalking: ASTM D 4214
Color Change and Conformity: ASTM D 2244
Weatherometer: ASTM G 23 and ASTM D 822
Humidity: ASTM D 2247 and ASTM D 714
Salt Spray: ASTM B 117
Chemical Pollution: ASTM D 1308
Gloss at 60: ASTM D 523
Pencil Hardness: ASTM D 3363
Reverse Impact: ASTM D 2794
Flexibility: ASTM D 522
Abrasion: ASTM D 968
Flame Spread: ASTM E 84

2.2 MISCELLANEOUS METAL FRAMING

2.2.1 General

Cold-formed metallic-coated steel sheet conforming to ASTM A 653/A 653M and specified in Division 05 Section 05 40 00 "Cold-Formed Metal Framing"

unless other wise indicated.

2.2.2 Fasteners for Miscellaneous Metal Framing

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to substrates in accordance with the wall panel manufacturer's and ASCE/SEI 7-05 requirements.

2.3 FASTENERS

2.3.1 General

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to substrates in accordance with the wall panel manufacturer's and ASCE/SEI 7-05 requirements.

2.3.2 Exposed Fasteners

Fasteners for wall panels to be corrosion resistant coated steel, aluminum, stainless steel, or nylon capped steel compatible with the sheet panel or flashing and of a type and size recommended by the manufacturer to meet the performance requirements and design loads. Fasteners for accessories to be the manufacturer's standard. Provide an integral metal washer matching the color of attached material with compressible sealing EPDM gasket approximately 3/32 in. thick.

2.3.3 Screws

Screws to be corrosion resistant coated steel, aluminum and/or stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.3.4 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.3.5 Attachment Clips

Fabricate clips from steel hot-dipped galvanized in accordance with ASTM A 653/A 653M, or Series 300, 305 stainless steel. Size, shape, thickness and capacity as required meeting the insulation thickness and design load criteria specified.

2.4 ACCESSORIES

2.4.1 General

All accessories to be compatible with the metal wall panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the wall panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips to be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.4.2 Rubber Closure Strips

Closed-cell, expanded cellular rubber conforming to ASTM D 1056 and ASTM D 1667; extruded or molded to the configuration of the specified wall panel and in lengths supplied by the wall panel manufacturer.

2.4.3 Metal Closure Strips

Factory fabricated aluminum, steel closure strips to be the same gauge thickness, color, finish and profile of the specified wall panel.

2.4.4 Joint Sealants

2.4.4.1 Sealants and Caulking

Sealants are to be an approved gun type for use in hand- or air-pressure calking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F) with minimum solid content of 85 percent of the total volume. Sealant is to dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weather-tight joint. No migratory staining is permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Prime all joints to receive sealants with a compatible one-component or two-component primer as recommended by the wall panel manufacturer.

2.4.4.2 Shop-Applied

Sealant for shop-applied caulking must be an approved gun grade, non-sag one component polysulfide or silicone conforming to ASTM C 920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.4.4.3 Field-Applied

Sealant for field-applied caulking must be an approved gun grade, non-sag one component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and conforming to ASTM C 920, Type II. Color to match panel colors.

2.4.4.4 Tape Sealant

Pressure sensitive, 100% solid with a release paper backing; permanently elastic, non-sagging, non-toxic and non-staining as approved by the wall panel manufacturer.

2.5 SHEET METAL FLASHING AND TRIM

2.5.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.6 REPAIR OF FINISH PROTECTION

Repair paint for color finish enameled wall panel must be compatible paint of the same formula and color as the specified finish furnished by the wall panel manufacturer.

PART 3 EXECUTION

3.1 EXAMATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of the Work.

B. Examine primary and secondary wall framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal wall panel manufacturer, UL, ASTM, ASCE/SEI 7-05 and as required for the geographical area where construction will take place.

C. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

D. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

E. Submit to the Contracting Officer a written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Miscellaneous Framing: Install sub-purlins, girts, angles, furring, and other miscellaneous wall panel support members and anchorage according to metal wall panel manufacturer's written instructions.

3.3 WALL PANEL INSTALLATION

Provide metal wall panels of full length from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement in accordance with MBMA Metal Building Systems Manual.

1. Steel Wall Panels: Use stainless-steel fasteners for exterior surfaces and galvanized steel fasteners for interior surfaces.

2. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for exterior surfaces and aluminum or galvanized steel fasteners for interior surfaces.

3. Anchor Clips: Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturer's written instructions.

4. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

5. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Bent, chipped, or defective sheets shall not be applied.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting metal wall panels by torch is not permitted.

3.4 FASTENER INSTALLATION

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturer's written instructions.

3.5 FLASHING, TRIM AND CLOSURE INSTALLATION

3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

Sheet metalwork is to be accomplished to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.5.2 Metal Flashing

Exposed metal flashing is to be installed at building corners, sills and eaves, junctions between metal siding and walling.

Exposed metal flashing is to be the same material, color, and finish as the

specified metal wall panel.

Flashing is to be fastened at not more than eight (8) inches on center, except where flashing are held in place by the same screws that secure covering sheets.

Flashing is to be furnished in at least eight (8) foot lengths. Exposed flashing is to have 1 inch locked and blind-soldered end joints, and expansion joints at intervals of not more than sixteen (16) feet.

Exposed flashing and flashing subject to rain penetration to be bedded in the specified joint sealant.

Flashing which is in contact with dissimilar metals to be isolated by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Drips to be formed to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.5.3 Closures

Install metal closure strips at open ends of corrugated or ribbed pattern walls, and at intersection of wall and wall unless open ends are concealed with formed eave flashing; and in other required areas.

Install mastic closure strips at intersection of the wall with metal walling; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.6 WORKMANSHIP

Make lines, arises, and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight.

3.7 ACCEPTANCE PROVISIONS

3.7.1 Erection Tolerances

Erect metal wall panels straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions. Horizontal lines must not vary more than 1/8 inch in 40 feet.

3.7.2 Leakage Tests

Finished application of metal wall panels are to be subject to inspection and test for leakage by the Contracting Officer, Architect/Engineer. Inspection and tests will be conducted without cost to the Government.

Inspection and testing is to be made promptly after erection to permit correction of defects and the removal and replacement of defective materials.

3.7.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials. Finished repaired surfaces must be uniform and free from variations of color and surface texture.

Repaired metal surfaces that are not acceptable to the project requirements are to be immediately removed and replaced with new material.

3.7.4 Paint-Finish Metal Siding

Paint-finish metal siding will be tested for color stability by the Contracting Officer during the manufacturer's specified guarantee period.

Panels that indicate color changes, fading, or surface degradation, determined by visual examination, must be removed and replaced with new panels at no expense to the Government.

New panels will be subject to the specified tests for an additional year from the date of their installation.

3.8 CLEAN-UP AND DISPOSAL

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces to be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

Collect and place scrap/waste materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site; transport demolished materials from government property and legally dispose of them.

-- End of Section --

SECTION 07 52 00

MODIFIED BITUMINOUS MEMBRANE ROOFING

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI ES-1	(2003) Wind Design Standard for Edge Systems Used with Low Slope Roof Systems

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2005; Supp 1) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE/SAFE A10.24	(2006) Roofing - Safety Requirements of Low-Sloped Roofs
ASSE/SAFE Z87.1	(2003) Standard for Occupational and Educational Eye and Face Protection

ASPHALT ROOFING MANUFACTURER'S ASSOCIATION (ARMA)

ARMA 410BUR88	(2001) Manual of Roof Maintenance and Repair
ARMA 460LSR97	(2002) NRCA/MRCA Repair Manual for Low Slope Membrane Roof Systems
ARMA PMBRG98	(1998) Quality Control Guideline for the Application of Polymer Modified Bitumen Roofing

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1153	(1997; R 2003e1) Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging
ASTM C 1289	(2007) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 208	(1995; R 2001) Cellulosic Fiber Insulating Board

ASTM C 552	(2007) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 726	(2005) Mineral Fiber Roof Insulation Board
ASTM C 728	(2005) Perlite Thermal Insulation Board
ASTM D 1668	(1997a; R 2006) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D 1863	(2005) Mineral Aggregate Used on Built-Up Roofs
ASTM D 2170	(2007) Kinematic Viscosity of Asphalts (Bitumens)
ASTM D 2824	(2006) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos
ASTM D 312	(2000; R 2006) Standard Specification for Asphalt Used in Roofing
ASTM D 4073	(2006) Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes
ASTM D 41	(2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4402	(2006) Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D 4586	(2007) Asphalt Roof Cement, Asbestos-Free
ASTM D 4601	(2004) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4637	(2004) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D 4897	(2001) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM D 5147	(2007b) Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
ASTM D 6162	(2000a) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D 6163	(2000e1) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using

	Glass Fiber Reinforcements
ASTM D 6164	(2005) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM D 6222	(2002e1) Atactic Polypropylene (ARP) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM D 6223	(2002e1) Atactic Polypropylene (ARP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D 6298	(2005) Fiberglass Reinforced Styrene-Butadiene-Styrene (SBS) Modified Bituminous Sheet with Factory Applied Metal Surface
ASTM D 6848	(2002) Aluminum Pigmented Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM E 108	(2007a) Fire Tests of Roof Coverings

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM AS 4470	(1986; R 1992) Class I Roof Covers
FM P7825	(2005) Approval Guide
FM P7825c	(2005) Approval Guide Building Materials

MIDWEST ROOFING CONTRACTORS ASSOCIATION (MRCA)

CERTA	(2003) NRCA/MRCA Certified Roofing Torch Applicator Program

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2004) Safeguarding Construction,Alteration, and Demolition Operations
NFPA 58	(2004; Amendment 2007) Liquefied Petroleum Gas Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA Details	(2003) NRCA Roof Perimeter Flashing Systems Construction Details for Class 1 Roof Construction
NRCA RWM	(2003) Roofing and Waterproofing Manual

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(2006) Architectural Sheet Metal Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.12	Construction Work
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.16	Rules of Construction

UNDERWRITERS LABORATORIES (UL)

UL 790	(2004) Test Methods for Fire Tests of Roof Coverings
UL RMSD	(2007) Roofing Materials and Systems Directory

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEMS

Minimum two-ply SBS, modified bitumen roof membrane consisting of modified bitumen base sheet, fiberglass felt, venting, base sheet, interply sheet and cap sheet. Modified bitumen roof membrane must be set in hot asphalt, torch applied, set in cold-applied adhesive.

_____: Minimum two-ply, three-ply, SBS or APP modified bitumen roof membrane consisting of modified bitumen base sheet, fiberglass felt venting base sheet, interply sheet and cap sheet. Modified bitumen roof membrane must be set in hot asphalt, torch applied, set in cold-applied adhesive.

All work must follow the NRCA RWM guidelines and standards stated within this Section.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roof plan; drawing depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, as applicable

SD-03 Product Data

Modified Bitumen Sheets

Asphalt

Cold-Applied Membrane Adhesive

Fiberglass Felt

Primer

Modified Bitumen Roof Cement

re-Manufactured Accessories

Fasteners And Plates

Vapor Pressure Relief Vents

Sample Warranty certificate

Submit all data required by Section 07 22 00 ROOF AND DECK INSULATION, together with requirements of this section. Include in data written acceptance by the roof membrane manufacturer of the products and accessories provided. Products must be as listed in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-05 Design Data

Wind Uplift Calculations

Provide Engineering calculations, signed, sealed, and dated by a qualified Engineer validating the wind resistance per ASCE 7, ASTM D 4073, and ANSI/SPRI ES-1 of non-rated roof system.

SD-07 Certificates

Provide evidence that products used within this specification are manufactured in the United States.

Qualification of Manufacturer

Certify that the manufacturer of the modified bitumen membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator."

Qualification of Engineer of Record

Certify that the Engineer of Record is fully qualified, competent, and currently licensed to practice in the project jurisdiction.

Bill of Lading

Submit bill of lading when labels of asphalt containers do not bear the flash point (FP), finished blowing temperature (FBT), and equiviscous temperature (EVT).

Wind Uplift Resistance classification, as applicable

Fire Resistance classification

Submit the roof system assembly wind uplift and fire rating classification listings.

SD-08 Manufacturer's Instructions

Modified Bitumen Membrane Application

Flashing

Temperature Limitations for Asphalt

Torches

Cold Adhesive Applied Modified Bitumen Membrane

Base Sheet attachment, including pattern and frequency of mechanical attachments required in field of roof, corners, and perimeters to provide for the specified wind resistance.

Primer

Roof Cement

Fasteners

Ventilating Base Sheets

Coating Application

Cold Weather Installation

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications. Include membrane manufacturer requirements for nailers and backnailing of roof membrane on steep slopes. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To Government, Contractor Personnel

Include copies of Material Safety Data Sheets for maintenance/repair materials.

Submit 20 year "No-Dollar-Limit" warranty for labor and materials.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Modified bitumen sheet roofing system manufacturer must have a minimum of 5 years experience in manufacturing modified bitumen roofing products.

1.4.2 Qualification of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the modified bitumen sheet roofing system manufacturer and have a minimum of five years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator must supply the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Fire Resistance

Complete roof covering assembly must:

a. Be Class A or B rated in accordance with ASTM E 108, FM 4470, or UL 790; and

b. Be listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM P7825.

FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

1.4.4 Wind Uplift Resistance

Complete roof covering assembly, including insulation, must be rated Class 1-90 in accordance with FM P7825 and ASTM D 4073 capable of withstanding an uplift pressure of 130 mph. Non-rated systems must not be installed, except as approved by the Contracting Officer. Provide wind load calculations and submit engineering calculations with substantiating data to validate wind resistance of any non-rated roof system. Base all Wind uplift calculationson a design wind speed of 130 mph in accordance with ASCE 7, ASTM D 4073, or applicable building code requirements.

1.4.5 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

a. Drawings, including Roof Plan, specifications and submittals related to the roof work

   Field inspection and verification of all existing conditions, including all fire safety issues, existing structure, and existing materials, including concealed combustibles, which may require additional protection during installation.

b. Roof system components installation

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roof structure, and roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer

d. Contractor's plan for coordination of the work of the various

trades involved in providing the roofing system and other components secured to the roofing

e. Quality control, (ARMA PMBRG98) plan for the roof system installation

f. Safety requirements

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, designated safety personnel trained to enforce and comply with ASSE/SAFE A10.24, Fire Marshall, and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification, the container must bear the specification number, type, and class, as applicable. Labels or bill of lading for roofing asphalt must indicate asphalt type, FP, FBT, and EVT, that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with ASTM D 2170 or 75 centipoise when tested in accordance with ASTM D 4402. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

Maintain a minimum distance of 35 foot for all stored flammable materials, including materials covered with shrink wraps, craft paper and/or tarps from all torch/welding applications.

Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the

Contracting Officer.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 40 degrees F, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

1.7 TORCH, HOT-MOPPED ASPHALT APPLIED (HEAT WELD), MODIFIED BITUMEN MEMBRANE SAFETY

1.7.1 Property Protection

Take all precautions necessary to prevent ignition of combustible materials during torch application, hot-mopped asphalt application of roofing. Immediately call the fire department if a fire commences. Review all fire safety procedures as outlined at the pre-roofing conference.

Install materials using the techniques recommended by CERTA NRCA/MRCA Certified Roofing Torch Applicator Program available from the National Roofing Contractors Association (NRCA) and the Midwest Roofing Contractors Association (MRCA} as endorsed by the Asphalt Roofing Manufacturers Association (ARMA) and the United Union of Roofers, Waterproofers and Allied Workers. Application procedures must comply with NFPA 241, OSHA 29 CFR 1910 and 29 CFR 1910.12, 29 CFR 1926.16, 29 CFR 1926 Subpart F., UL Fire Resistance Directory Volume No. 1, NRCA R&W Manual, and Florida Building Code Volume 2004.

Do not store flammable liquids on the roof.

Provide a minimum of two 2.65 gallon containers of water and two fully charged minimum 20 pound ABC (dry chemical) fire extinguishers in separate, easily accessible locations on the roof and within 30 foot, 10 foot of each torch work area, hot-mopped kettle at all times.

No Asphalt/Tar Kettles are allowed on roofs. Locate kettles and supply LP-Gas Cylinders safely and secured per NFPA 241 outside of the building's perimeter a minimum of 20 foot from the structure and any combustible materials.

Maintain a minimum separation of 20 foot between LP-Gas Cylinders and kettle. Provide protective fire retardant blanket barrier or shield between any building structure to a minimum height of 8 foot and a clear surround distance of 4 foot if operations force placement of kettle within a distance of 20 foot. Do not obstruct or place kettles or Cylinder storage within 10 foot of exits, means of egress, gates, roadways, entrances. Locate kettles downwind and away from any building air intakes.

Provide a minimum of two portable fully charged 20 pound ABC (dry chemical) fire extinguishers no closer than 5 foot and no further than 25 foot of horizontal travel distance from each kettle at all times while kettle is in operation, in easily accessible and identifiable locations. Also provide a

minimum of one, two multipurpose 2-A:20-B:C portable fire extinguisher on the roof being covered or repaired.

Comply with the following safety procedures:

a. Fuel containers, burners, and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating must comply with the requirements of NFPA 58.

b. Fuel containers having capacities greater than one pound must be located a minimum of 10 foot clear distance from the burner flame.

c. All LP-Gas Cylinders must be clearly labeled "Flammable Gas", and secured to prevent accidental tip-over.

d. Check all pressure regulators and hoses prior to use for proper functioning and integrity.

e. Turn off fuel supply at LP Gas Cylinder when kettle is not in use.

f. Equip all kettles with a functioning temperature measuring device to ensure no heating in excess of 50 degrees F below the flash point.

g. Provide covers, lid, or top which are close fitting, constructed of minimum No.14 manufacturer's gauge steel, and can be gravity closed on all kettles.

h. Clean all roofing mops and rags free of excess asphalt and store safely away from all combustible materials. Store discarded roofing mops and rags in a non-combustible container and remove from site each day.

i. Position all pump lines handling hot asphalt securely and equip all pump lines with a shut-off valve on each with a coupler which may be opened when lines are full. Do not subject pump lines to pressures in excess of safe and recommended NRCA and ARMA working pressures. Station an operator near the equipment to cut off flow and care for other emergencies while conducting heating, pumping and application operations.

j. Asphalt/tar bucket used by roofers or workers in similar trades must be constructed of minimum No. 24 gauge or heavier sheet steel and have a metal bail of no less than 1/4 inch diameter material. The bail is to be fastened to offset ears or equivalent which have been riveted, welded, or otherwise safely and securely attached to the bucket. Soldered bail sockets are prohibited. Position workers and other employees to avoid being struck by bucket or other roofing materials, which may accidentally fall while being hoisted, lowered, or used in the roofing operation. Provide safety barriers and caution signs at all skylights or other roof holes.

k. Do not use flammable liquids with a flash point below 100 degrees F (gasoline and similar products) for cleaning purposes.

Do not use solid fuel or Class I liquids as fuel for roofing asphalt/tar kettles. Provide a minimum of one employee fully knowledgeable of kettle operations and hazards to maintain constant surveillance during kettle

operation within a minimum distance of 25 foot of the kettle.

Check all fire extinguishers prior to commencement of work, and upon completion of the day's work, to ensure fullness and operability.

Project supervisor must make daily inspections with the facility manager of all conditions and operations which could present hazards during torching, hot-mopped applications and issue directives to address all such concerns and items of the work and existing conditions.

Identify and protect all combustible roof components, possible fire traps, and hidden hazards. Seal off voids or openings in the substrate with non-combustible materials prior to installing torch-applied, hot-mopped applied materials in the area. Install protective fire retardant blankets and shields at building walls, eaves, parapets and equipments curbs constructed of combustible materials within 3 foot radius of the area of torch work, hot-mopped kettle prior to commencement of the work.

When working around intakes and openings, temporarily disconnect and block to prevent flame of torch, fumes from kettle from being drawn into the opening. Provide non-combustible shielding or flame guard protection where gaps or voids occur in the construction in area of torch work.

1.7.2 Fire Watch

All personnel on the roof during torch application, hot-mopped application must be properly trained to use a fire extinguisher. Provide a fire watch for a minimum of two hours after completion of all torch work, 30 minutes after completion of hot-mopped kettle operations at the end of each work shift. Maintain the fire watch for additional time required to ensure no potential ignition conditions exist. Utilize heat sensing meters to scan for hot spots in the work. For torch applications, provide and utilize a minimum of one certified heat detection gun per torch for use during the fire watch to verify cool, safe and non-combustible conditions exist. Provide a minimum duration fire watch of two hours conducted by personnel properly trained to survey the underside of the roof deck (where possible) and the topside of possible smoldering elements.

Do not torch in areas of poor and/or no visibility (curbs, corners, eaves, expansions joints, flashing, other voids and small penetrations) which could allow a torch flame to ignite combustible material(s) hidden from view or within the underside of the roof deck or building interior. Use cold finish applications in these areas whenever possible and per manufacturer's printed instructions, NRCA 4002, MRCA R&NW manual for "cold adhered" materials.

Do not leave the rooftop unattended during breaks in work during a work shift. Walk and scan all areas of application checking for hot spots, fumes, or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift.

1.7.3 Open Flame Application (Torch) Equipment and Personnel Safety

Only NRCA/MRCA CERTA certified roofing applicators are allowed to operate any torching equipment. Verify that all such applicators maintain and are currently carrying a valid Certified Roofing Torch Applicator (CERTA) card.

All crew members must be trained in preventive measures for indirect and

direct dangers and hazards associated with roofing work, which include, but are not limited to the following:

a. Heat Stress: Wear light colored clothing, a hat for ultra-violet protection, and other eye protective devices. Dink sufficient quantities of non-alcoholic, non-caffeine liquids. Stage shifts for crew members to allow for breaks from heat and sun exposure without interfering with work progress.

b. First Aid for Burns: Immediately call for an ambulance. Contact local Occupational Health Services (OHS).

All crew members must wear correct personal protective equipment (PPE), including. but not limited to the following items:

a. Long-sleeved shirts buttoned at the collar and cuffs,and must be made of non-flammable materials. Polyester materials are not allowed.

b. Work boots covering ankles with rubber or composite soles.

c. Long pants without cuffs to extend over the top of the work boots, and must be made of non-flammable materials. No polyester allowed.

d. Heavy leather gloves and/or flame retardant gauntlets which must be worn during all handling of a torch, whether operating or not.

e. OSHA and ASSE/SAFE Z87.1 approved face shields, goggles and/or safety glasses to be worn during torching and any other applicable roofing functions.

f. OSHA and ANSI approved hard hats.

1.7.4 Wind Conditions

Use side shields with all torching operations when winds are occurring to prevent flame distortion of end burners. Use torch machine equipment with bottom shield plate to prevent flame spread on to roof deck and substrate. When high wind gusts are present, notify the safety officer and cease all use of torching equipment until wind conditions lower and authorization from the safety officer to proceed is received.

1.8 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counter flashing, per NRCA Details, and are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Application of roofing must immediately follow application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.9 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements.

1.9.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 30-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation in compliance with ASTM C 1289, and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

c. Damage to the roofing system caused by sustained winds having a velocity of 130 mph or less is covered by the warranty.

d. Upon completion of installation, and acceptance by the Contracting Officer, Architect, Construction Manager and Roofing System Engineer of Record, the manufacturer must supply the appropriate warranty to the Owner.

e. Installer must submit a minimum two year warranty to the membrane manufacturer from the date of acceptance, with a copy to the Contracting Officer, Architect, Construction Manager and Roofing System Engineer of Record.

1.9.2 Roofing System Installer Warranty

The roof system installer must warrant for a period of not less than two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Make warranty directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials are the responsibility of the roof system installer. All costs associated with the repair or replacement work are the responsibility of the installer.

1.9.3 Continuance of Warranty

Repair or replacement work, ARMA 410BUR88, ARMA 460LSR97 that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.10 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system must be in accordance with specified and indicated requirements, including fire and wind resistance (ANSI/SPRI ES-1) requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA Roofing and Waterproofing Manual, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

PART 2 PRODUCTS

2.1 MODIFIED BITUMEN SHEETS AND FIBERGLASS FELT MATERIALS

Furnish a combination of specified materials that comprise the modified bitumen manufacturer's standard system of the number and type of plies specified. Materials provided must be suitable for the service and climatic conditions of the installation. Modified bitumen sheets must be watertight and visually free of pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Polymer modifier must comply with ARMA PMBRG98 and be uniformly dispersed throughout the sheet. Edges of sheet must be straight and flat.

a. Venting Base Sheet: ASTM D 4897, Type II, without/with perforations and as approved by the modified bitumen roof membrane manufacturer.

b. Fiberglass Felt Base Sheet: ASTM D 4601,ASTM D 1668 Type II, without/with perforations and as approved by the modified bitumen roof membrane manufacturer.

c. SBS Base Sheet: ASTM D 6162 or ASTM D 6164 or ASTM D 6163, Type I or II, Grade S, minimum 2.0 mm (80 mils) thick.

d. SBS Interply Sheet: ASTM D 6162 or ASTM D 6164 or ASTM D 6163, Type I or II, Grade S, minimum 2.0 mm (80 mils) thick.

e. SBS Cap Sheet: ASTM D 6162 or ASTM D 6164 or ASTM D 6163; Type II, Grade G or S, minimum 3.7 mm (145 mils) thick at selvage edge, and as required to provide specified fire safety rating.

f. APP Base Sheet: ASTM D 6222, Type I or II; or ASTM D 6223; Grade G or S minimum 3.5 mm (140 mils) thick at the selvage edge.

g. APP Cap Sheet: ASTM D 6222, Type II; or ASTM D 6223; Grade G or S, minimum 4.0 mm (160 mils) thick at selvage edge.

2.2 BASE FLASHING MEMBRANE

Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the roof membrane specified and as recommended in membrane manufacturer's published literature. Flashing membranes must meet or exceed the properties of the material standards specified for the modified bitumen base, interply and cap sheet, except that flashing membrane thickness must be as recommended by the membrane

manufacturer. Metal clad flashing membrane must comply with ASTM D 6298.

2.3 ASPHALT

ASTM D 312, Type III, in accordance with modified bitumen membrane manufacturer requirements and compatible with the slope conditions of the installation.

2.4 COLD-APPLIED MEMBRANE ADHESIVE

Membrane manufacturer's recommended low volatile organic compound (VOC) cold process adhesive for application of the membrane plies.

2.5 MEMBRANE SURFACING

Provide modified bitumen roof membrane cap sheet with factory-applied granule surfacing of light color as selected from membrane manufacturer's standard colors. Provide modified bitumen membrane manufacturer's recommended field-applied protective coating of white color. Aluminized coating must comply with ASTM D 2824 or ASTM D 6848, Type I or III, as recommended by the modified bitumen roof membrane manufacturer. Light colored, opaque water-worn gravel aggregate surfacing material conforming to ASTM D 1863, or other aggregate as recommended by the membrane manufacturer and approved by the Contracting Officer, and applied in flood coat of hot asphalt.

2.6 PRIMER

ASTM D 41, or other primer compatible with the application and as approved in writing by the modified bitumen membrane manufacturer.

2.7 MODIFIED BITUMEN ROOF CEMENT

ASTM D 4586, Type II for vertical surfaces, Type I for horizontal surfaces, compatible with the modified bitumen roof membrane and as recommended by the modified bitumen membrane manufacturer.

2.8 CANT AND TAPERED EDGE STRIPS

Provide standard cants and tapered edge strips of perlite conforming to ASTM C 728, the same material as the roof insulation or when roof insulation material is not available, provide pressure preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the manufacturer, or wood fiber conforming to ASTM C 208 treated with bituminous impregnation, sizing, or waxing and fabricated to provide maximum 45 degree change in direction of membrane. Cant strips must be minimum 1-1/2 inch thick and provide for minimum 5 inch face and 3-1/2 inch vertical height when installed at 45 degree face angle, 4 inch vertical height with 45 degree cant angle, except where clearance restricts height to lesser dimension. Taper edge strips at a rate of one to 1-1/2 inch per foot to a minimum of 1/8 inch of thickness. Provide kiln-dried preservative-treated wood cants, in compliance with requirements of UFGS Section 06 10 00 ROUGH CARPENTRY at base of wood nailers set on edge and wood curbing and where otherwise indicated.

2.9 FASTENERS AND PLATES

Provide coated, corrosion-resistant fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the

requirements of FM AS 4470 and FM P7825c for Class I roof deck construction and the wind uplift resistance specified. For fastening of membrane or felts to wood materials, provide fasteners driven through 1 inch diameter metal discs, or one piece composite fasteners with heads not less than 1 inch in diameter or 1 inch square with rounded or 45 degree tapered corners.

2.9.1 Masonry or Concrete Walls and Vertical Surfaces

Use hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 1 inch long for securing felts, modified bitumen sheets, metal items, and accessories to masonry or concrete walls and vertical surfaces. Use power-driven fastenersonly when approved in writing by the Contracting Officer.

2.9.2 Metal Plates

Provide flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM AS 4470; not less than 2 inch in diameter. Form discs to prevent dishing or cupping.

2.10 PRE-MANUFACTURED ACCESSORIES

Pre-manufactured accessories must be manufacturer's standard for intended purpose, comply with applicable specification section, compatible with the membrane roof system and approved for use by the modified bitumen membrane manufacturer.

2.10.1 Vapor Pressure Relief Vents

Provide vents manufactured for the purpose of releasing vapor pressure from the roofing system by heat and pressure. Vents must be one-way type design to prevent reverse flow of moisture laden air into roofing system. Valve cap must effectively seal out wind-blown rain, snow, and not permit water entry if submerged.

2.10.2 Pre-fabricated Curbs

Provide as indicated. _____ gauge G90 galvanized, AZ55 galvalume curbs with minimum 4 inch flange for attachment to roof nailers. Curbs must be minimum height of 10 inch above the finished roof membrane surface.

2.10.3 Elevated Metal Walkways and Platforms

As specified in UFGS Sectionn 05 50 00 METALS: MISCELLANEOUS AND FABRICATIONS.

2.11 WALKPADS

Roof walkpads must be polyester reinforced, granule-surfaced modified bitumen membrane material, minimum as indicated (as indicated mils) thick, compatible with the modified bitumen sheet roofing and as recommended by the modified bitumen sheet roofing manufacturer. Panels mustnot exceed 4 foot in length. Other walkpad materials require approval of the Contracting Officer prior to installation.

2.12 PAVER BLOCKS

Precast concrete, minimum 1-1/2 inch thick, minimum 18 inch square for walkways and minimum 6 inch by 12 inch for use in supporting surface bearing components but extending not less than 2 inch beyond all sides of surface bearing bases. Install walkpad material under all paver blocks.

2.13 ROOF INSULATION BELOW MODIFIED BITUMEN MEMBRANE SYSTEM

Insulation must be compatible with the roof membrane, approved by the membrane manufacturer and meeting all the requirements of ASTM C 552, ASTM C 578, ASTM C 726 as specified in UFGS Section 07 22 00 ROOF AND DECK INSULATION.

2.14 MEMBRANE LINER

Provide self-adhering modified bitumen underlayment conforming to ASTM D 1970, EPDM membrane liner conforming to ASTM D 4637, or other waterproof membrane liner material as approved by the Contracting Officer.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. Drains, curbs, cants, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.

c. The plane of the substrate does not vary more than 1/4 inchwithin an area 10 by 10 foot when checked with a 10 foot straight edge placed anywhere on the substrate.

d. Substrate is sloped as indicated to provide positive drainage.

e. Walls and vertical surfaces are constructed to receive counter flashing, and will permit mechanical fastening of the base flashing materials.

f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inch above finished roofing surface.

g. Protect all combustible materials and surfaces which may contain concealed combustible or flammable materials. All fire extinguishing equipment has been placed as specified.

h. Verify all Fire Watch personnel assignments.

i. Treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and

roof fixtures. Embedded nailers are flush with deck surfaces. Surface-applied nailers are the same thickness as the roof insulation.

j. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than 3-1/2 inch.

k. Venting is provided in accordance with the following:

(1) Edge Venting: Perimeter nailers are kerfed across the width of the nailers to permit escape of gaseous pressure at roof edges.

(2) Underside Venting: Vent openings are provided in steel form decking for cast-in-place concrete substrate.

(3) Vapor pressure relief vents: Holes equal to the outside diameter of vents are provided through the insulation where vents are required. Space vents in accordance with membrane manufacturer's recommendations.

l. Exposed nail heads in wood substrates are properly set. Warped and split boards, sheets have been replaced. There are no cracks or end joints 1/4 inch in width or greater. Knot holes are covered with sheet metal and nailed in place. Wood, Plywood decks are covered with rosin paper or unsaturated felt prior to base sheet or roof membrane application. Joints in plywood substrates are taped or otherwise sealed to prevent air leakage from the underside.

m. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

n. Cast-in-place substrates have been allowed to cure and the surface dryness requirements specified under paragraph entitled "Field Quality Control" have been met.

o. Joints between precast concrete deck units are grouted, leveled, nd stripped in with felt or bituminous stripping membrane set in bituminous cement prior to applying other roofing materials over the area.

p. Roof deck and framing are sloped as indicated to provide positive drainage.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoists, tankers, and kettles prior to starting the work. Lap protective coverings not less than 6 inch, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

3.2.1.2 Bitumen Stops

Provide felt bitumen stops or other means to prevent bitumen drippage at roof edges, openings, and vertical projections before hot mopped application of the roofing membrane.

3.2.2 Equipment

3.2.2.1 Mechanical Application Devices

Mount mechanical application devices on pneumatic-tired wheels. Use devices designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

3.2.2.2 Flame-Heated Equipment

Do not place flame-heated equipment on roof. Provide and maintain a fire extinguisher adjacent to flame-heated equipment and on the roof.

3.2.2.3 Open Flame Application Equipment

Torches and other open flame equipment must be specifically designated for use in application of modified bitumen materials and approved by the modified bitumen sheet manufacturer. Open flame equipment must not be ignited (burning) when left unattended. Provide and maintain a fire extinguisher adjacent to open flame equipment on the roof. Specific requirements for fire watches and burn permits exist. These requirements will be reviewed at the preroofing conference.

3.2.2.3 Electric-Heated Equipment

Provide adequate electrical service as required by manufacturer of electrical equipment to ensure against damage to equipment and property and to ensure proper application of roofing materials.

3.2.3 Heating of Asphalt

Break up solid asphalt on a surface free of dirt and debris. Heat asphalt in kettle designed to prevent contact of flame with surfaces in contact with the asphalt. Kettles must have visible working thermometer and thermostatic controls set to the temperature limits specified herein. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus 1.8 degrees F, to check temperatures of the asphalt frequently. When temperatures exceed maximums specified, remove asphalt from the site. Do no permit cutting back, adulterating, or fluxing of asphalt.

3.2.3.1 Temperature Limitations for Asphalt

Heat and apply asphalt at the temperatures specified below unless specified otherwise by manufacturer's printed application instructions. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its finished blowing temperature (FBT). Do not heat asphalt between 500 and 525 degrees F for longer than four consecutive hours. Do not heat asphalt to the flash point (FP). Apply asphalt and embed membrane sheets when temperature of asphalt is within plus or minus 25 degrees F of the equiviscous temperature (EVT) but not less than 400 degrees F. Before

heating and application of asphalt refer to the asphalt manufacturer's label or bill of lading for FP, FBT, and EVT of the asphalt used.

3.2.4 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 0.75 gallon per 100 sq. ft. or as recommended by modified bitumen sheet manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane applications.

3.2.4.1 Priming of Concrete and Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive membrane materials uniformly with primer.

3.2.4.2 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roof system prior to setting in bituminous materials or stripping into roofing system.

3.2.5 Membrane Preparation

Unroll modified bitumen membrane materials and allow to relax a minimum of 30 minutes prior to installation. In cold weather, adhere to membrane manufacturer's additional recommendations for pre-installation membrane handling and preparation. Inspect for damage, pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Edges of seams must be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles. Discard damaged or defective materials.

3.2.6 Substrate Preparation

Apply membrane to clean, dry surfaces only. Don not apply membrane to surfaces that have been wet by rain or frozen precipitation within the previous 12 hours. Provide cleaning and artificial drying with heated blowers or torches as necessary to ensure clean, dry surface prior to membrane application.

3.3 APPLICATION

Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt. Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system.

3.3.1 Phased Membrane Construction

Phased application of membrane plies is prohibited unless otherwise approved by the Contracting Officer and supported by the membrane manufacturer's written application instructions. If cap sheet installation is delayed, thoroughly clean the applied membrane material surface and dry immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the

Contracting Officer prior to cap sheet installation.

3.3.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing cooling towers, antennas, pipes, ducts, is to be performed on the roof or where construction scheduling or weather conditions require protection of the building's interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing.

3.3.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of the permanent roofing system.

3.3.3 Application Method

3.3.3.1 Hot Asphalt Application of Modified Bitumen Membrane

Apply membrane immediately following application of hot asphalt. Apply hot asphalt within 6 foot of roll. Do not work ahead with asphalt. Asphalt must be completely fluid, with mop temperatures within the asphalt's EVT range, but not less than 400 degrees F, at the instant membrane comes into contact with asphalt. Application of bitumen between layers must be such as to provide full, continuous, uniform coverage and complete contact of hot asphalt with the sheet above and below. Embed sheets in asphalt. As sheets are being rolled into hot asphalt, immediately and thoroughly apply uniform positive pressure by squeegee, roll, or broom to ensure full adhesion and lap seal, eliminate trapped air and to provide tight, smooth laminations. Avoid excessive extrusion of asphalt at lap areas. Control asphalt bleed out to approximately 25.4 mm 1 inch maximum.

3.3.3.2 Torch Applied Heat Welded Modified Bitumen Membrane Flashing

Base flashing membrane may be torch applied. Ensure substrate membrane surfaces are warmed either naturally or by torch during the installation. Apply heat evenly to underside of roll membrane being installed and exposed side lap area of previously installed sheet. Provide for slight, uniform flow of bitumen in front of roll and full width of roll as the material is being rolled or set into place. Apply uniform positive pressure to ensure membrane is fully adhered and all laps are sealed. Prior to forming lap over granulated surfaces, embed granules of the receiving sheet by heating and troweling-in the granules to form a uniform black compound surface. Roll all lap areas with a weighted roller immediately after forming lap. Provide for visual bleed out of compound in lap areas. Avoid overheating the membrane or burning through to membrane reinforcement. Inspect and ensure all lap areas are fully sealed.

3.3.3.3 Cold Adhesive Applied Modified Bitumen Membrane

Apply cold adhesive with airless sprayer or 1/4 inch saw-toothed rubber squeegee to prepared surfaces in accordance with membrane manufacturer's application instructions. Fully cover substrate with adhesive. Roll or lay membrane in adhesive in accordance with manufacturer's recommendations and within the time limitations of adhesive application. Broom the membrane to ensure full contact with adhesive. Seal laps with adhesive or by heat fusing with torch or hot air welder as required by membrane

manufacturer. Minimize traffic on installed membrane during the adhesive cure and set time.

3.3.4 Ventilating Base Sheets

Apply ventilating base sheets with 3 inch side laps and 6 inch end laps in accordance with manufacturer's printed application instructions for substrate and wind uplift conditions specified. Mechanical attachments must be as required for wind resistance specified and to include increased frequency of attachment at corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Top mop perforated sheet with a full, continuous mopping of hot asphalt.

3.3.5 Fiberglass Felt Modified Bitumen Base Sheet

Fully adhere, spot adhere base sheets in accordance with membrane manufacturer's printed instructions. Spot adhesion must be with hot asphalt applied in 12 inch diameter spots installed in two staggered rows, centered 12 inch in from edge of the base sheet. Apply cold adhesive with airless sprayer or a 1/4 inch saw-toothed rubber squeegee and at application rate recommended by the membrane manufacturer. Fully cover substrate with cold adhesive. Ensure laps areas of base sheet are fully sealed. Roll and broom in the base sheet to ensure full contract with the hot asphalt, adhesive application. On nailable substrates, mechanically fasten base sheet in conformance with specified wind resistance requirements and membrane manufacturer's printed instructions, and to include increased fastening frequency in corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Where applicable, mechanically fastenbase sheet in conjunction with insulation to the substrate, in accordance with membrane manufacturers printed instructions. Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 2 inch unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 6 inch and staggered a minimum of 36 inch. Apply sheets at right angles to the roof slope so that the direction of water flow is over and not against the laps parallel to the roof slope so that plies of sheets extend from eave line on one side of the barrel-type roof and 18 inch over the center line of the crown of the roof. Apply sheets on the other side in the same manner, resulting in twice the normal amount of roofing sheets and asphalt at the crown. Extend base sheets approximately 2 inch above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Application must be free of ridges, wrinkles, and buckles.

3.3.6 Modified Bitumen Membrane Application

Ensure proper sheet alignment prior to installation. Apply membrane layers perpendicular to slope of roof in shingle fashion to shed water, including application on areas of tapered insulation that change slope direction. Apply membrane layers parallel to slope of roof. Bucking or backwater laps are prohibited. Fully adhere membrane sheets to underlying substrate materials. Provide minimum 3 inch side laps and minimum 6 inch end laps and as otherwise required by membrane manufacturer. Stagger end laps minimum 36 inch. Offset side laps between membrane layers a minimum of 12 inch. Offset end laps between membrane layers a minimum of 36 inch. Install all membrane layers the same workday, unless supported otherwise by roof membrane manufacturer application instructions and approved by the Contracting Officer. Provide tight smooth laminations of each membrane

layer without wrinkles, ridges, buckles, kinks, fishmouths, or voids. Ensure full membrane adhesion and full lap seals. Rework to seal any open laps prior to application of subsequent membrane layers. The completed membrane application must be free of surface abrasions, air pockets, blisters, ridges, wrinkles, buckles, kinks, fishmouths, voids, or open seams.

3.3.6.1 Cap Sheet Installation

Underlying applied membrane must be inspected and repaired free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Do not apply cap sheet if rain or frozen precipitation has occurred within the previous 24 hours. Align cap membrane and apply by the specified method with the proper side and end lap widths. Set cap sheet in hot asphalt or torch apply as recommended by the modified bitumen membrane manufacturer. Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. Apply matching granules in any areas of bitumen, adhesive bleed out while the asphalt is still hot, adhesive is still tacky. Minimize traffic on newly installed cap sheet membrane.

3.3.7 Membrane Flashing

Apply two-ply modified bitumen strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Apply membrane flashing in accordance with the roof membrane manufacturers printed instructions and as specified. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of modified bituminous base flashing 150 mm (6 inches) on center through minimum 1 inch diameter tin caps with fasteners of sufficient length to embed minimum one inch into attachment substrate. Apply matching granules in any areas of asphalt, adhesive bleed out while the asphalt is still hot, adhesive is still tacky. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components. Metal flashing per SMACNA Arch. Manual guidelines and standards is specified under UFGS Section 07 60 00 FLASHING AND SHEET METAL. Do not set metal flashing in hot asphalt.

3.3.7.1 Membrane Strip Flashing

Set primed flanges of metal flashing in full bed of modified bituminous cement material and securely fasten through to attachment substrate. Strip-in with membrane flashing so that strip extends not less than 4 inch beyond outer edge of flange. Where multiple membrane stripping plies are installed, extend each additional stripping ply minimum 4 inch beyond edge of previous ply.

3.3.7.2 Membrane Flashing at Roof Drain

Roof drains are specified in UFGS Section 22 00 00 PLUMBING, GENERAL PURPOSE. Flashing for roof drains, is specified in UFGS Section 07 60 00 FLASHING AND SHEET METAL. Extend membrane sheets to edge of drain bowl

opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Securely clamp membrane sheets and metal roof drain flashing and strip flashing in the flashing clamping ring. Secure clamps so that sheets and metal flashing are free from wrinkles and folds. Trim stripping must be flush with inside of clamping ring.

3.3.7.3 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flash with modified bitumen membrane.

3.3.7.4 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.7.5 Lightning Protection

Flash and attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacturer.

3.3.8 Roof Walkpads

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Provide minimum 6 inch separation between adjacent walkpads to accommodate drainage. Provide walkpad or an additional layer of cap sheet under precast concrete paver blocks to protect the roofing.

3.3.9 Elevated Metal Walkways and Platforms

Install over completed roof system in accordance with UFGS Section 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS. Provide protection mat of walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

3.3.10 Paver Blocks

Install paver blocks where indicated and as necessary to support surface bearing items traversing the roof area. Set paver block on a layer of walkpad or cap sheet applied over the completed roof membrane.

3.3.11 Vapor Pressure Relief Vents

Provide vents in a uniform pattern and at a minimum rate of one for each 1000 square feet of roof area. Space and install in strict accordance with manufacturer's instructions. Cut a hole, of diameter to suit base opening size of vent, through the roofing membrane and down to the deck vapor barrier material surface. Fill the cut out with loose fill fiberglass or crumbled polyisocyanurate insulation. Set vent flange over hole on top of roofing membrane in a 1/8 inch thick bed of modified bitumen roof cement or special adhesive or cement recommended by vent manufacturer. Strip-in

vent flanges with strip flashing membrane and provide bead of modified bitumen sealant at membrane termination at base of vent.

3.3.12 Field Applied Surfacing

After completion of roof membrane and flashing installation, and correction of tears, gouges, and other deficiencies in the installed work, apply specified surfacing.

3.3.12.1 Aggregate

Uniformly flood coat the surface with hot asphalt at a rate of approximate 60 pounds per square. While asphalt is still hot, apply gravel aggregate surfacing material at a rate of 400 pounds per square or 300 pounds per square for slag or other approved aggregate surfacing. Provide for full and uniform coverage of the roof surface. Solidly adhere approximately 50 percent of the aggregate in the asphalt.

3.3.12.2 Coating Application

Apply surface coating materials to membrane and flashing in accordance with coating material manufacturer's recommendations.

3.3.13 Correction of Deficiencies

Where any form of deficiency is found, additional measures will be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions must be performed as directed by the Contracting Officer.

3.3.14 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.4 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system from water intrusion.

3.4.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system in an effective manner. Seal off flutes in metal decking along the cutoff edge. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.4.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashing can be applied. Remove temporary flashing before applying permanent flashing.

3.4.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied

roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.5 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.5.1 Test for Surface Dryness

Before application of membrane sheets and starting work on the area to be roofed, perform test for surface dryness in accordance with the following:

a. Foaming: When poured on the surface to which membrane materials are to be applied, one pint of asphalt when heated in the range of 350 to 400 degrees F, must not foam upon contact.

b. Strippability: On cementitious substrate surfaces, after asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from the surface, do not consider the surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been tested by the method above and found dry.

3.5.2 Construction Monitoring

During progress of the roof work, Contractor must make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Materials comply with the specified requirements.

b. Materials are not installed in adverse weather conditions.

All materials are properly stored, handled and protected from moisture or other damages.

c. Equipment is in working order. Metering devices are accurate.

d. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

(1) Nailers and blocking are provided where and as needed.

Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

(2) The proper number, type, and spacing of fasteners are installed.

Membrane heating, hot mopping, or adhesive application is provided uniformly and as necessary to ensure full adhesion of roll materials. Asphalt is heated and applied within the specified temperature range.

The proper number and types of plies are installed, with the specified overlaps.

Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

(3) Lap areas of all plies are completely sealed.

Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.

Installer adheres to specified and detailed application parameters.

Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Temporary protection measures are in place at the end of each work shift.

3.5.2.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three _____ times, once per week during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections must not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.5.3 Samples of Roofing

Take samples per ASTM D 5147, sized 4-inch by 40-inch cut across width of modified bitumen sheets as directed by the Contracting Officer. Cut samples will be examined by the Contracting Officer for specified number of plies, proper lap width, complete lap seal, full uniform adhesive compound application and adhesion, full bond between plies, harmful foreign materials, presence of moisture, and wet insulation. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area in bed of modified bitumen cement. Repair area of cut with new minimum two-ply modified bitumen membrane patch.

3.5.4 Roof Drain Test

After completing roofing, but prior to Government acceptance, perform the following test for watertight integrity. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

3.6 INFRARED INSPECTION

Eight months after completion of the roofing system, the Contractor must inspect the roof surface using infrared (IR) scanning as specified in ASTM C 1153. Where the IR inspection indicates moisture intrusion, wet insulation and damaged or deficient materials or construction must be replaced in a manner to provide watertight construction and maintain the specified roof system warranties.

3.7 INSTRUCTIONS TO GOVERNMENT, CONTRACTOR PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the modified bitumen membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.8 INFORMATION CARD

For each roof, furnish a typewritten information card for facility Records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.039 inch thick aluminum card for exterior display. Card must be 8 1/2 by 11 inch minimum. Information card must identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor barrier material; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. The card must be a minimum size of 8 1/2 by 11 inch. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

-- End of Section --

SECTION 07 53 80

ELASTOMERIC SHEET ROOFING SYSTEMS (CPA)

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 751	(2000) Coated Fabrics
ASTM D 1149	(1991; R1999) Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 1204	(1994) Linear Dimensional Changes of Non-Rigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D 2316	(1984 R 1989) Coated Fabrics - Low Temperature Bend Test
ASTM D 2565	(1999) Operating Xenon Arc-Type Light-Exposure Apparatus With and Without Water for Exposure of Plastics
ASTM E 108	(2000) Fire Tests of Roof Coverings
ASTM G 21	(1996) Determining Resistance of Synthetic Polymeric Materials to Fungi

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-101	(Rev. C) (Change Notice 3) Packaging Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM A/S4470	(1986; R 1988) Class I Roof Covers
FM P7825a	(1998) Approval Guide Fire Protection

UNDERWRITERS LABORATORIES (UL)

UL Roof Mat Dir	(1999) Roofing Materials and Systems Directory
UL 790	(1997; Rev thru Jul 1998) Tests for Fire Resistance of Roof Covering Materials

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

CPA sheet

Submit membrane manufacturer's drawing indicating locations of two way air vents, spacing of perimeter and infield fasteners, and seaming data. The drawing shall reflect the project roof plan of each roof level and conditions indicated.

SD-03 Product Data

CPA sheet

Adhesive

Sealant

Flashing and flashing accessories

Fasteners and plates

Roof insulation

Submit all data required by Section 07 22 00, "Roof and Deck Insulation," together with requirements of this section. Data shall include written acceptance by the roof membrane manufacturer of the insulation to be provide.

SD-07 Certificates

Qualifications of applicator

Qualifications of manufacturer

Certify that applicator meets requirements specified under paragraph entitled "Qualifications of Applicator", and include names and locations of 5 qualified installations and the roofing system manufacturer's approval of applicator. Submit CPA sheet manufacturer meets the requirements specified under paragraph entitled "Qualifications of Manufacturer."

SD-08 Manufacturer's Instructions

CPA sheet

Flashing and flashing accessories

Water cutoff mastic

Fasteners and plates

Include detailed application instructions and standard installation detail drawings where applicable.

SD-11 Closeout Submittals

Information card

Instructions to Government personnel

1.2.1 Information Card Contents

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

1.2.2 Written Instructions to Government Personnel

Submit instructions meeting the requirements of paragraph entitled "Instructions to Government Personnel" and include copies of Material Safety Data Sheets (MSDS) for maintenance/repair materials.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications of Applicator

Roofing system applicator shall be approved by the CPA sheet roofing system manufacturer and shall have a minimum of three years experience as an approved applicator with that manufacturer. Applicator shall have applied 20,000 squares of manufacturer's material.

1.3.2 Qualifications of Manufacturer

CPA sheet manufacturer shall have manufactured the membrane specified herein for at least 15 years.

1.3.3 Fire Safety

Complete roof covering assembly shall:

a. Have ASTM E 108, Class IA UL 790, Class A classification; and

b. Be listed as Fire-Classified roof deck construction in the UL Roof Mat Dir, or Class I roof deck construction in FM P7825a.

1.3.4 Wind Uplift

Complete roof covering assembly shall be rated Class I-120 in accordance with FM P7825a capable of withstanding an uplift pressure of 120 pounds per square foot.

1.3.5 Preroofing Conference

After approval of submittals and before performing roofing and insulation work, including associated work, the Contracting Officer will hold a preroofing conference to review the following:

a. Drawings and specifications;

b. Procedures for onsite inspection and acceptance of roofing substrate and pertinent structural details relating to the roofing system;

c. Contractor's plan for coordination of work of the various trades involved in providing the roofing system and other components secured to the roofing; and

d. Safety requirements

Preroofing conference shall be attended by the Contractor and personnel directly responsible for installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, and a representative of the roofing materials manufacturer. Before beginning roofing work, confirm in writing the resolution of conflicts among those attending the preroofing conference.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in manufacturer's original unopened containers or wrappings with manufacturer's labels intact and legible. Roll wrappings shall be intact, without tears. Do not use rolls found with torn wrapping or which show evidence of having been opened when delivered onsite. Where materials are covered by referenced specification number, labels shall bear the specification number, type, class, compliance, with UL requirements, date of manufacturer, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow the work to proceed without interruption.

1.4.2 Storage

Store and protect materials from damage and weather in accordance with manufacturer's instructions, except as specified otherwise. Keep materials clean and dry. Use pallets to support and canvas tarpaulins to completely cover stored material. Do not use polyethylene sheet as a covering. Locate materials temporarily stored on the roof in approved areas. Distribute the load to stay within live load limits of the roof construction. Do not double-stack CPA loaded pallets. Place only those materials to be used during one day's work on the roof at one time. Remove unused materials from the roof at the end of each day's work.

1.4.3 Handling

When hazardous materials are involved, adhere to special precautions of the manufacturer and the applicable MSDS. Adhesives contain petroleum distillates and are extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame. Do not use materials contaminated by exposure to moisture. Remove contaminated materials from the site.

1.5 ENVIRONMENT REQUIREMENTS

Do not install elastomeric sheet roofing during high winds or inclement weather, or when there is ice, frost, moisture, or visible dampness on the substrate surface. Unless recommended otherwise by the CPA sheet manufacturer, do not install CPA sheet when air temperature is below 40 degrees F or within 5 degrees F of the dewpoint.

1.6 WARRANTY

Furnish the roofing manufacturer's premium warranty for the roofing system,

including insulation, flashing, and accessories. The warranty shall run directly to the Government. In no event shall the warranty period be less than 15 years from the date of the Government's acceptance of the work, notwithstanding roofing applicator's or manufacturer's unpaid invoices for installation, supplies, or service. The warranty shall state that:

a. When within the warranty period the CPA sheet roofing system becomes nonwatertight, splits, tears, or separates at the seams because of defective materials and workmanship, the repair or replacement of defective materials and correction of defective workmanship shall be the responsibility of the CPA sheet manufacturer.

b. When the manufacturer or the manufacturer's approved applicator fail to perform repairs within 72 hours of notification, emergency repairs performed by others will not void the warranty; and

c. Damage to the CPA roofing system caused by sustained winds having a velocity of 100 miles per hour or less is covered by the warranty.

1.7 DESIGN REQUIREMENTS

The entire roofing and flashing system shall be designed by the roofing membrane manufacturer to meet the requirements of this section under the conditions encountered at the site of the work for the specific building's configuration.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 CPA Sheet

Co-polymer alloy CPA 40-mil nominal thickness with high strength polyester scrim for mechanically fastened application. Width and length of sheet shall be as recommended by the manufacturer. CPA polymer shall represent 90 percent by weight minimum of the total polymer portion of the thermoplastic compound.

2.1.2 Scrim Reinforced Sheet

Scrim reinforced CPA sheet shall be high strength, minimum 10 by 12 polyester and have the following values when tested for the listed properties in accordance with the listed test method:

PROPERTY	VALUE	TEST METHOD
Thickness, min., inch	.050	ASTM D 751
Tensile Strength, min., lbs/in	300	ASTM D 751
Elongation, min., percent	35	ASTM D 751
Tear Strength, min., lbs/in. (Tongue tear 8 inch by 8 inch sample)	90	ASTM D 751
Low Temperature Flexibility	Pass	ASTM D 2316

PROPERTY	VALUE	TEST METHOD
at -40 degrees		
Linear Dimension Change, max., percent	.2	ASTM D 1204
Ply Adhesion, min., lbf/in.	10.0	ASTM D 751 Type A Specimen
Hydrostatic Resistance, min., psi	500	ASTM D 751
Puncture Resistance min., lbs/in.	225	FED-STD-101 Test Method 2031
Ozone Resistance (7 by Magnification 28 Days/40 degrees C/100 ppm)	No cracks	ASTM D 1149 Method B
Accelerated Weather Resistance 5,000 Hours (7 by Magnification)	No checking, cracking or crazing	ASTM D 2565 Type BH2
Fungi Resistance	No sustained growth or discoloration	ASTM G 21 21 days

2.1.3 Adhesive

As supplied and warranted by the CPA sheet manufacturer's printed data.

2.1.4 Water Cutoff Mastic and Sealant

As recommended by the CPA sheet manufacturer's printed data.

2.1.5 Flashing and Flashing Accessories

Flashing, including perimeter flashing and flashing around roof penetrations, shall be the same material as field sheet, either reinforced or nonreinforced, or as recommended by the CPA sheet manufacturer's printed instructions. Provide reinforced 50-mil, membrane for field-fabricated vent stack flashing, pipe flashing, and corners.

2.1.6 Fasteners and Plates

Non-corrosive, as supplied and warranted by the CPA sheet manufacturer's printed data, and conforming to requirements of FM A/S4470. Fasteners shall no penetrate the deck, except for metal decking only.

2.1.7 CPA Walkboard

2.1.8 Roof Insulation Below CPA Sheet

Insulation shall be compatible with membrane as recommended in membrane manufacturer's printed instructions and as specified in Section 07 22 00,

"Roof and Deck Insulation."

PART 3 EXECUTION

3.1 PREPARATION

Coordinate work with that of other trades to ensure that components which are to be incorporated into the roofing systems are available to prevent delays or interruptions as work progresses. Examine substrate to which roofing material is to be applied to ensure that its condition is satisfactory for roofing application of a negative pressure system. Substrate shall be sealed at all perimeters and penetrations. Concrete substrates shall be cured and free of Latinate and curing compounds. Install wood blocking at perimeters, curbs, and penetrations of use in mechanically attaching and air sealing the membrane, unless recommended otherwise by the CPA sheet manufacturer's printed instructions. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges, and debris. Inspect substrates, and correct defects before application of CPA sheets.

3.2 MEMBRANE INSTALLATION

3.2.1 Laying Out

Select the proper factory marked rolled sheet of roofing membrane for an outside corner or high point. Orient the roofing membrane so that the fastening tabs are perpendicular to the ribs or corrugations of a steel deck or perpendicular to the width of the prestressed concrete "T" slabs, et. When laying out each tab, pull the membrane tight.

3.2.2 Field Welding

All field heat seams of the roofing materials shall be 1-1/2 inch wide minimum and be made with a hot air welder. The hot air welder shall be in such a position so that the outside edge and both pieces of material will receive an equal amount of heat and all of which will be closely followed by wide roller specially designed for this purpose. Make a hands and knees inspection of all field welds with a probe.

3.2.3 Perimeter Nailing

The membrane shall be mechanically fastened at all roof perimeters, parapets, curbs, wall, penetrations, etc. in strict accordance with the contract documents and roofing manufacturer's specifications and details.

3.2.4 Cut-Outs

Make cut-outs in roofing membrance for protrusions through the roof. Some situations might require that the deck membrane be slit to the section edge for fitting around protrusions. Fasten around cut-outs with approved fasteners, 12 inches on center or a minimum of one per side. The skirts on factory prefabricated accessories when welded to deck will cover these.

3.2.5 Stacks

After membrane has been attached, select proper size of premanufactured round stack for roof vents and pipes. Drop stack flashing over the pipe, lay flat to the roof, and heat weld the skirt to the deck membrance. Using appropriate hand tool, tighten stainless steel band (or stainless steel

screw clamp) around top of stacvk flashing to prevent water penetration, and cut off excess. Using factory approved sealant, liberally seal the top of the stack flashing and steel band.

3.2.6 Custom Curbs/Pitch Pockets

After securing cut-out as stated, heat weld the botton of te skirt to the deck membrane. If the square or rectangle prentration has a removalb top, i.e. roof hatch, skylight, etc., remove the unit and fold the custom curb flashing over the top, secure, then replace unit. If top is not removable, secure the top of the custom curb flashing with termination bar and seal with factory approved sealant. Use this same procedure on existing or new pitch pockets.

3.2.7 Breather Vents

Install a two-way breather vent for every 1,000 square feet of deck area. Factory prefabricated vents with a skirt made from roofing membrane shall be used. For new construction or reroof after tear-off, a 2-1/2 inch diameter hole cut down through the roofing membrane and insulation facer is required. For recover/non-tear-off application a 2-1/2 inch diameter hole is to be cut throught the roofing membrane and the facer down to the facer on the existing insulation. Heat weld skirt to the deck membrane so as to position two-way vent directly over the hole. Careful placement of the breather vents must be observed. **DO NOT** locate in valleys, next to roof penetrations, scuppers, roof drains, etc. Equally space the vents throughout the roof area. Do not fasten the vent or the skirt to the roof deck. This two-way breather vent is designed to vent the roofing system only and not the building to which it is installed.

3.2.8 Parapet Walls

Fasten bottom tab of prefabricated parapet wall flashing 12 inches on center with approved fasteners. This fastening sequence will secure both bottom of parapet and edge of deck membrane. Base skirt should extend approximately 6 inches onto the roof. This allows for a 1-1/2 inch wide weld and covering of the fasteners and plates. Heat weld skirt to deck membrane. On all termination bar applications, start fastening at one end and proceed to the other. This will eliminate buckling of the termination bar. Seal behind the parapet wall material and on top of termination bar with factory approved sealant. If parapet wall coping is to be covered, extend covering down 2 inches on exterior face of coping and terminate accordingly.

3.2.9 Scuppers

Use of prefabricated custom roof scuppers is required. Terminate outside of scupper lining with termination bar as specified and field weld inside akirting to membrane. Apply sealant to underside of lining and top of termination bar.

3.2.10 Gutter Edge

a. If gutter is attached to building 2 inches or more below roof line, extend deck membrane over edge and terminate with termination bar and fasten 6 inches on center. Apply sealant as specified.

b. When the gutter is attached to the building level with the roof

line, notch the drip edge face around the gutter support brackets and install according to specifications.

3.2.11 Roof Drains

a. Secure cut-out made in deck membrane with four equally spaced fasteners and distribution plates. If drain is flush with deck, use a prefabricated drain boot. Apply factory approved sealant all around drain approximately 12 inches under deck membrane and install the expanding snap rings.

b. If the roof drain has a secure clamping ring and strainer, unbolt and remove. Clean and apply factory approved sealant under deck membrane around drain for use as a water block seal after cutting properly sized hole. Secure clamping ring and strainer to drain base over deck membrane. Seal with factory approved sealant between clamping ring and roofing membrane.

3.2.12 Expansion Joints/Valleys

a. Whendever encompassing an elevated mid-roof expansion joint, must use a prefabricated expansion joint section. This section shall allow loose layment over the joint nad approved fastening on either side. A 6 inch skirt on both sides will provide coverage of fasteners and still allow approximately 1-1/2 inch for a heat weld to deck membrane.

b. Valleys are worked in the same manner. Fasten according to specifications, 12 inches on center, and lap deck membrane over fasteners. Heat weld deck membrane to valley section.

3.2.13 Roof Tie-Ins

a. When terminating the roofing membrane onto an existing roof, care must be taken to stop any water from backing under the new deck membrane.

b. For tie-ins on flat roofs, i.e. wood, concrete, gypsum, tectum, etc., cut a 2-inch slot to substrate or vapor barrier. Apply sealant and terminate using termination bar secured 6-inches on cneter with approved fasteners. Fill slots with urethane foam sealant, level with roof line.

c. When the tie-in is perpendicular to the flutes of a steel deck, they must be filled level. Terminate according to above instructions.

d. On tie-ins into shingled pitch roof, secure on flat deck according to specifications 12-inches on center and fold membrance over fasteners and up under shingles. Apply approved sealant for water stop under membrane and terminate 3-inches on center with fasteners at a vertical height of not less than 12 inches.

3.3 APPLICATION

3.3.1 Work Sequence

Arrange work to prevent use of newly constructed roofing for storage, walking surface, or equipment movement. Where access is necessary, provide

temporary walkways, platforms, or runways to protect new roofing surfaces and flashings from mechanical damage.

3.3.2 CPA Sheet Roofing

Sheet shall be watertight and visually free of pinholes, particles of foreign matter, undispersed raw material, or other manufacturing defects that might affect serviceability. Edges of sheet shall be straight and flat so that sheets may be seamed to each other without fishmouthing. Clean surfaces to be seamed of cured activated CPA material prior to hot air seaming. Every seam made each day shall be 100 percent probed by the end of that day's work. Permanently mark and promptly repair each defect in accordance with manufacturer's repair recommendations.

3.3.2.1 Perimeter Fastening and Sealing

Mechanically secure CPA sheet to nailers at roof perimeter and penetrations with specified fastener and pressure bar, or as recommended by CPA sheet manufacturer's printed instructions. Seal between membrane and nailer or penetration with airseal caulk as specified by CPA manufacturer. Space fasteners a maximum of 6 inches o.c., except as recommended otherwise by CPA sheet manufacturer's printed data. Strip flash over fasteners with a fully adhered layer of flashing material. Type of flashing materials and procedures for strip flashing shall be as recommended in CPA sheet manufacturer's printed instructions.

3.3.2.2 Temporary Work

Install temporary cutoffs around incomplete edges of roofing assembly at the end of each days work and when work must be postponed due to inclement weather. Straighten insulation line using pieces of insulation loosely laid, and seal sheet membrane to deck. Remove temporary seals completely when work resumes. Provide temporary ballast on roofing as necessary to prevent wind damage to CPA sheet.

3.3.2.3 Flashing

Install flashing as roofing sheets are installed in accordance with printed instructions of CPA sheet manufacturer. Extend base flashing not less than 8 inches above roofing surface. Completely adhere flashing sheets in place. Provide prefabricated pipe seals at pipe penetrations where possible, otherwise field-fabricate pipe seals as specified in paragraph entitled "Flashing and Flashing Accessories."

3.3.2.4 Insulation

Insulation or protection board must be approved by CPA sheet manufacturer for use in mechanically attached application. Provide insulation manufacturer's approved fasteners and plates. Leave no voids between adjacent boards of insulation.

3.4 FIELD QUALITY CONTROL

3.4.1 Installation to Government Personnel

Furnish written and verbal instructions to designated Government personnel. Instructions shall be given by a competent representative of the CPA manufacturer and shall include a minimum of 4 hours on maintenance and emergency repair of membrane. Include demonstration of membrane

repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and repair operations.

3.5 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic for interior display, or a photoengraved 0.032-inch-thick aluminum card for exterior display. Card shall be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 located at end of this section. Install card near point of access to roof or where indicated. Send a photostatic paper copy to LANTNAVFACENGCOM, Code 103, Norfolk, VA 23511-6287.

FORM 1 - ROOFING SYSTEM DESCRIPTION

1. Location _____ 2. Bldg. Name _____

3. Bldg. No. _____ 4. Roof Area (SF) _____ 5. Contract No. _____

6. New Construction: ( ) Yes ( ) No 7. Deck Slope: _____

8. Type of Deck:
( ) Metal ( ) Wood Plank or Plywood
( ) Cast-In-Place Concrete ( ) Other _____
( ) Precast/Prestressed Concrete

9. Type of Insulation Board:
( ) Polyisocyanurate/Composite ( ) Polyisocyanurate Foam
( ) Polystyrene/Composite ( ) Polystyrene
( ) Perlite ( ) Mineral Fiber
( ) Other _____

10. Insulation Manufacturer: _____

11. Insulation Thickness: _____

12. Vapor Treatment: Total coverage ( ) Yes ( ) No
( ) No Vapor Retarder ( ) Bituminous Vapor Retarder
( ) One Way Roof Vents ( ) Laminated Kraft Paper
( ) Other _____

13. Vapor Treatment Manufacturer(s): _____

14. Roofing Type:
( ) Built-Up (Asphalt) ( ) PIB ( ) TPA
( ) Built-Up (Coal-Tar) ( ) Modified Bitumen ( ) EPDM
( ) Metal ( ) CSPE ( ) PVC
( ) Shingles ( ) Other _____

15. Roofing Manufacturer: _____

16. Roofing Installer/Warrantor: _____

17. Roofing Application Method:
( ) Bitumen ( ) Fully Adhered ( ) Loose-Laid
( ) Mechanically Fastened ( ) Torched Ballasted
( ) Mechanically Fastened/Fully Adhered ( ) Other _____

18. Warranty Period: From _____ To _____

19. Warranty Serial Number: _____

20. Date Roofing Completed: _____ 21. Inspector: _____

22. Prime Contractor Name/Address: _____

Signature: _____ Date: _____

INSTRUCTIONS FOR FORM 1 (Do Not Post)

1. Location: Name of activity as shown on contract.

2. Bldg. Name: As shown on contract or as provided by Contracting Officer.

3. Bldg. Number: As provided by Contracting Officer.

4. Roof Area: Area in square feet of roof for which deck insulation, membrane, etc. are the same. A separate form is required if any part of roof system is different over other areas of the roof.

5. Contract Number: As shown on the contract.

7. Show deck slope.

8. Deck: Check appropriate block.

9. Type of Insulation Board: Check appropriate block.

11. Show minimum thickness of installed insulation.

12. Vapor Treatment: Check appropriate blocks.

13. Show vapor treatment system manufacturer's name.

14. Roofing Type: Check appropriate block.

15. Show roofing manufacturer's name.

16. Roofing Installer's or Contractor's name.

17. Roofing Application Method: Check appropriate block.

18. Warranty Period: Insert start and end dates.

20. Show date roofing was accepted by the Contracting Officer. Warranty period begins on this date.

21. Show Government Inspector's name.

22. Prime Contractor Name/Address/Signature: Must be signed and dated by QC Manager, an official of Contracting firm.

-- End of Section --

SECTION 07 54 19

POLYVINYL CHLORIDE (PVC) ROOFING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(2007) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM D 4434	(2006) Poly(Vinyl Chloride) Sheet Roofing
ASTM D 448	(2003a) Sizes of Aggregate for Road and Bridge Construction
ASTM G 21	(1996; R 2002) Determining Resistance of Synthetic Polymeric Materials to Fungi

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(2005) Approval Guide Fire Protection
FM P9513	(2002) Specialist Data Book Set for Roofing Contractors; contains 1-22 (2001), 1-28 (2002), 1-29 (2002), 1-28R/1-29R (1998), 1-30 (2000), 1-31 (2000), 1-32 (2000), 1-33 (2000), 1-34 (2001), 1-49 (2000), 1-52 (2000), 1-54 (2001)

SINGLE PLY ROOFING INSTITUTE (SPRI)

SPRI RP-4	(2002) Wind Design Standard for Ballasted Single-Ply Roofing Systems

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006) Tests for Uplift Resistance of Roof Assemblies
UL 790	(2004) Test Methods for Fire Tests of Roof Coverings

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing System

Drawings showing arrangement of sheets, seam locations, and flashing details including waterproofing of joints where sheet metal flashings change direction. Shop drawings drawn by the manufacturer and certified by the Contractor for the specified system.

SD-03 Product Data

Installation

Manufacturer's instructions for preparing and installing the membrane, flashing, seams, insulation, nailers, and other accessories.

Protection of Finished Roofing

A protection plan showing areas to be protected, type of material used, a procedure to protect the membrane from damage until completion of work by other trades, and a description of the method of repairing the roofing.

Inspection

The inspection procedure for substrate suitability including decks, curbs and insulation installation, prior to start of the work. Inspection procedures during and after placement of the membrane, and after completion of work by other trades.

SD-07 Certificates

Materials

Certificates of compliance attesting that the materials meet specification requirements. The certificates shall list the components required for the specified rating.

Qualifications

Contractor's qualifications as specified.

1.3 GENERAL REQUIREMENTS

Polyvinyl Chloride (PVC) roofing shall be fully adhered, mechanically fastened, loose-laid ballasted to the roof surfaces indicated. Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical to minimize joints. Membrane shall be free of defects and foreign material. Flashing work shall be coordinated to permit continuous roof-surfacing operations. Insulation shall be applied and weatherproofed on the same day.

1.3.1 Delivery and Storage

Materials shall be delivered to the jobsite in the manufacturer's original unopened packages, clearly marked with the manufacturer's name, brand name, description of contents, and label for compliance with UL requirements.

Time limited materials shall be used before shelf life expires. Materials other than ballast shall be stored in clean, dry areas. Storage temperatures shall be as specified by the manufacturer. A maximum of one day's supply of materials other than ballast may be stored on the roof when distributed so as not to exceed the roof live load limit. These materials shall be kept dry and clean until application. Ballast shall be stored uncovered, shall not be in contact with sod or earth, and shall not be stored on the roof.

1.3.2 Fire Resistance

The roofing system fire resistance shall be rated Class A as determined by UL 790 or Class 1 as determined by FM P7825a. Compliance of each component of the roofing system shall be evidenced by label or by written certification from the manufacturer.

1.3.3 Wind Uplift Requirements

Wind uplift resistance of the complete roof assembly shall be rated Class I-60, 90 in accordance with FM P9513 or Class 60, 90 in accordance with UL 580. Wind resistance of loose-laid ballasted system shall be in accordance with FM P9513, SPRI RP-4.

1.3.4 Warranty

Manufacturer's standard warranty for 10, 15 years shall be furnished. Warranty shall provide for repair or replacement of the complete roofing system, including insulation and flashings, if leaking is caused by defects in materials or workmanship.

1.3.5 Qualifications

The Contractor shall submit documentation verifying that the Contractor has a minimum of 2 years experience with PVC roofing systems and has been certified by the PVC roofing manufacturer as an approved Installer for the specified PVC roofing system.

PART 2 PRODUCTS

2.1 SOLVENTS AND SEALANTS

Adhesives, welding solvents, and sealants shall be as recommended by the membrane manufacturer.

2.2 BALLAST

Ballast shall be concrete pavers and smooth round stone, screened gravel, or screened crushed stone, with gradations complying with ASTM D 448, Size 4, Sizes 2 and 4, except that particles passing the 3/8 inch sieve shall not exceed 2 percent. Unit weight of ballast shall be no less than 60 lbs/cu. ft when determined in accordance with ASTM C 29/C 29M. Concrete pavers shall be precast air-entrained concrete, minimum 1-1/2 inches thick, having 3000 psi minimum compressive strength. Pavers other than walkways shall include drainage channels on their lower surfaces or shall rest on membrane pads extending at least 1 inch beyond the paver edges.

2.3 FASTENERS

Fasteners for sheet-metal flashing shall be corrosion-resistant steel

annular-ring type nails, or screws. Fasteners for anchoring the roofing membrane shall be as approved by the membrane manufacturer and identical to those used to obtain the wind uplift rating.

2.4 FLASHINGS

Flashings shall be ultra-violet resistant materials furnished by the membrane manufacturer, except as otherwise specified. Shaped flashing components shall be prefabricated. Sheared edges of metal flashings that will contact the membrane shall be turned into a tight hem.

2.5 MEMBRANE

Membrane shall contain fibers or fabric, shall be at least 45, 60 mils thick, and shall comply with ASTM D 4434, Type II or III. Membrane shall be fungi resistant as demonstrated by "non sustained growth" or discoloration after 21 days exposure as specified in ASTM G 21.

2.6 PREFABRICATED ACCESSORIES

Pipe seals and expansion joint covers shall be types and sizes recommended by the membrane manufacturer.

2.7 SLIP SHEET

Slip sheets between insulation and membrane shall be as recommended by the membrane manufacturer.

2.8 WALKWAYS

Walkways shall be concrete pavers, at least 1-1/2 inches thick, with a non-skid top surface and as specified in paragraph BALLAST. Pavers for walkways less than 4 feet wide around mechanical equipment, or other features except drains, may rest directly on the membrane unless underlayment is specified by the manufacturer. Alternate walkway material may be used if recommended by the manufacturer and approved by the Contracting Officer.

PART 3 EXECUTION

3.1 ENVIRONMENTAL CONDITIONS

Membrane shall not be installed in high wind, inclement weather or when there is visible ice, frost or moisture on the deck or membrane. Unless otherwise specified by the manufacturer, membrane shall not be installed when air temperature is below 40 degrees F or within 5 degrees F of the dew point.

3.2 PREPARATION

The substrate of any bay or section of the building shall be complete and suitable for insulation and membrane installation before roofing is begun. Roofing on lightweight insulating concrete shall not begin until the concrete passes the air-dry density test specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. Insulation under roofing shall comply with Section 07 22 00 ROOF AND DECK INSULATION. Surfaces on or against which membrane is applied shall be smooth, clean, and free from oil, grease, sharp edges, standing water, and construction debris. Joints over 1/4 inch wide shall be filled with insulation material. Wood nailers shall

comply with Section 06 10 00 ROUGH CARPENTRY.

3.3 INSTALLATION

Installation shall comply with the manufacturer's approved instructions except as otherwise specified.

3.3.1 Membrane

Membrane shall not be placed directly on concrete deck or other hard surface which may damage the membrane. Unless otherwise specified by the manufacturer, the membrane shall be rolled out on the surface and allowed to relax for at least 1/2 hour when ambient temperature is 60 degrees F or higher or 2 hours when ambient temperature is below 60 degrees F prior to other installation activities. Membrane shall be overlapped a minimum of 3 inches at sides and minimum 4 inches at ends. Direction of laps shall allow water to flow over and not into the lap. Membrane joints shall be free of wrinkles and fishmouths. The entire length of joints shall be probe-tested and corrected during the day of installation. Defective areas shall be re-sealed. Wrinkles, fishmouths, or damaged areas shall be cut out and the area covered with membrane using a 3 inch seam on all sides. Repairs shall be probe-tested for continuity. Bonded areas of seams shall be a minimum 3 inches wide for bonded seams and 2 inches wide for heat-welded seams.

3.3.2 Nailing

Membrane shall be fastened to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, nails shall be staggered on 4 inch centers maximum; screws for sheet metal shall be staggered on 8 inch centers maximum; and a row of fasteners shall be at least 1/2 inch from edges of sheet metal.

3.3.3 Flashing

Roof edges, projections through the roof and changes in roof planes shall be flashed. The seam between the flashing and the membrane shall be completed before the flashing is bonded to vertical surfaces. The seam shall be sealed a minimum of 3 inches beyond the fasteners which attach the membrane to nailers. The installed flashings shall be secured at the top of the flashing a maximum of 12 inches on centers under the counterflashing or cap. Where possible, prefabricated components shall be used for pipe seals and flashing accessories.

3.3.4 Expansion Joints

Expansion joints shall be covered using Prefabricated covers or elastomeric flashing in accordance with the recommendations of the manufacturer.

3.3.5 Cutoffs

If work is terminated prior to weatherproofing the entire roof, the membrane shall be sealed to the roof deck. Flutes in metal decking shall be sealed off along the cutoff edge. Membrane shall be pulled free or cut to expose the insulation when resuming work and cut insulation sheets used for fill-in shall be removed. Asphalt or coal-tar products shall not be used for sealing.

3.3.6 Walkways

Walkways shall be installed on a loose-laid pad of the membrane material extending at least 1 inch beyond the walkway material, and as specified by the manufacturer. Stone ballast shall not be placed below or above walkways.

3.4 BALLAST APPLICATION

Ballast shall be applied as the membrane is installed to prevent wind uplift, except that seams and terminations shall be left uncovered until completion of inspection and repair. Membrane shall be protected from mechanical damage during ballast application. Minimum ballast weight shall not be less than required by FM P9513 or UL 580, indicated. Ballast shall be spread as indicated, recommended by the membrane manufacturer for the anticipated wind conditions. Unless otherwise specified, size 2 ballast shall be applied at a rate of 13 to 15 psf and size 4 ballast shall be applied at a rate of 10 to 12 psf.

3.5 PROTECTION OF FINISHED ROOFING

The roofing membrane shall be protected from damage by other trades. After completion of work by other trades, the protection shall be removed and the roof shall be inspected. Any damage shall be repaired in accordance with the recommendation of the roofing manufacturer.

3.6 INSPECTION

If non-destructive surveys by the Government indicate presence of wet insulation during the first year, first 2 years after completion of the work, the Contractor shall take samples to verify the extent of the moisture, and shall replace wet insulation and the defective membrane.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI RD-1	(20035) Standard for Retrofit Roof Drains

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2003; Errata 2004) Structural Welding Code - Aluminum

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 308/A 308M	(2006) Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 101	(2007) Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 32	(2004) Standard Specification for Solder Metal
ASTM B 370	(2003) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B 69	(2001a; R 2005) Standard Specification for

	Rolled Zinc
ASTM D 1784	(2007) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 41	(2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4586	(2007) Asphalt Roof Cement, Asbestos-Free

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(2006) Architectural Sheet Metal Manual

1.2 General Requirements

Finished sheet metalwork will form a weathertight construction without waves, warps, buckles, fastening stresses or distortion, which allows for expansion and contraction. Sheet metal mechanic is repsonsible for cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous roofing operations.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Covering on flat, sloped, or curved surfaces

Gutters

Downspouts

Expansion joints

Gravel stops and fascias

Splash pans

Flashing for roof drains

Base flashing

Counterflashing

Flashing at roof penetrations

Reglets

Scuppers

Copings

Drip edge

Conductor heads

Open valley flashing

Eave flashing

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

SD-11 Closeout Submittals

Quality Control Plan

Submit for sheet metal work in accordance with paragraph entitled "Field Quality Control."

1.4 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use lead, lead-coated metal, or galvanized steel. Use any metal listed by SMACNA Arch. Manual for a particular item, unless otherwise specified or indicated. Conform to the requirements specified and to the thicknesses and configurations established in SMACNA Arch. Manual for the materials. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items must be copper.

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

2.1.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascias; cap, valley, steeped, base, and eave flashings and related accessories.

2.1.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.1.3 Copper, Sheet and Strip

ASTM B 370, cold-rolled temper, H 00 (standard).

2.1.4 Lead-Coated Copper Sheet

ASTM B 101.

2.1.5 Lead Sheet

Minimum weight 4 pounds per square foot.

2.1.6 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A 653/A 653M.

2.1.6.1 Finish

Exposed exterior items of zinc-coated steel sheet must have a baked-on, factory-applied color coating of polyvinylidene fluoride or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Provide finish coating dry-film thickness of 0.8 to 1.3 mils and color as indicated.

2.1.7 Zinc Sheet and Strip

ASTM B 69, Type I, a minimum of 0.024 inch thick.

2.1.8 Stainless Steel

ASTM A 167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.9 Terne-Coated Steel

Minimum of 14 by 20 inch with minimum of 40 pound coating per double base box. ASTM A 308/A 308M.

2.1.10 Aluminum Alloy Sheet and Plate

ASTM B 209, as indicated form alloy, and temper appropriate for use.

2.1.10.1 Alclad

When fabricated of aluminum, fabricate the items Alclad 3003, Alclad 3004, Alclad 3005, clad on one side, both sides unless otherwise indicated.

a. Gutters, downspouts, and hangers

b. Gravel stops and fascias

c. Flashing

2.1.10.2 Finish

Exposed exterior sheet metal items of aluminum must have a baked-on, factory-applied color coating of polyvinylidene fluoride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Provide finish coating dry-film thickness of 0.8 to 1.3 mils, and color as indicated.

2.1.11 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B 221.

2.1.12 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.13 Polyvinyl Chloride Reglet

ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness.

2.1.14 Bituminous Plastic Cement

ASTM D 4586, Type I.

2.1.15 Roofing Felt

ASTM D 226 Type I, Type II.

2.1.16 Asphalt Primer

ASTM D 41.

2.1.17 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Metal Roofing

3.1.1.1 Flat Copper, Zinc, Terne-coated Steel Roofing

Before applying roofing, cover deck with rosin-sized roofing felt. Lap 2 inch at joints and secure in place with roofing nails. Using solder of equal parts tin and lead, solder slowly with well-heated irons to thoroughly heat sheet and completely sweat solder through full width of seam. Tin edges of copper to be soldered at least 3/4 inch before sheets are locked. Use stainless nails in terne-coated steel; in copper, use solid copper or bronze roofing nails, in zinc, use zinc-coated roofing nails. Where roof decks abut vertical surfaces, turn metal roofing up vertical surfaces about 8 inch where practicable; where vertical surfaces

are covered with applied materials, turn up roofing behind applied materials. Use standing-seam method for roofs having rise of more than 3 inch per foot, and use flat-seam method when rise is 3 inch per foot or less. Walking not permitted directly on metal roofs; provide approved walkways.

3.1.1.2 Standing-seam Method

Make standing seams parallel with slope of roof. Fabricate sheets into long lengths at shop by locking short dimensions together and thoroughly soldering joints thus formed. In applying metal, turn up one edge of course at each side seam at right angles 1.5 inch. Then install 2 by 3 inch cleats spaced 12 inch apart by fastening one end of each cleat to roof with two one inch long nails and folding roof end back over nail heads. Turn end adjoining turned-up side seam up over upstanding edge of course. Turn up adjoining edge of next course 1.75 inch and abutting upstanding edges locked, turned over, and flattened against one side of standing seam. Make standing seams straight, rounded neatly at the top edges, and stand about one inch above roof deck. All sheets must be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA Arch. Manual.

3.1.1.3 Flat-seam Method

Lay metal so short dimension is parallel to gutter or eave lines and so water will flow over and not into seams. Make seams by turning edges of sheet 3/4 inch and lock and solder together. If sheets are laid one at a time, secure to roof deck with cleats, using three cleats to each sheet, two on long side and one on short side. Use cleats inch wide, hooked over 3/4 inch upturned edges of sheets, and nail to roof deck with two one inch long nails. Turn back roof end of cleat over nail heads before next sheet is applied. If desired, sheets may be made into long lengths at shop by locking short dimensions together and soldering seams thus formed. Turn long lengths 3/4 inch, and secure each length to roof deck by cleats spaced 12 inch apart. Mallet and solder seams after pans are in place." All sheets to be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern, as shown in SMACNA Arch. Manual.

3.1.2 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA Arch. Manual, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.3 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inch. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inch on center and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.

3.1.4 Cleats

Provide cleats for sheet metal 18 inch and over in width. Space cleats evenly not over 12 inch on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inch wide by 3 inch long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. Pretin cleats for soldered seams.

3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 0.040 inch or less in thickness.

3.1.6 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.6.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.6.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inch.

3.1.6.3 Loose-Lock Expansion Seams

Not less than 3 inch wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed.

3.1.6.4 Standing Seams

Not less than one inch high, double locked without solder.

3.1.6.5 Flat Seams

Make seams in the direction of the flow.

3.1.7 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pretin edges of sheet

metal before soldering is begun. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.7.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pretinned. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.8 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 0.040 inch. Aluminum 0.040 inch or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

3.1.8.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2/D1.2M.

3.1.8.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 12 inch maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inch from the end of the overlapping sheet.

3.1.9 Protection from Contact with Dissimilar Materials

3.1.9.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.9.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.1.9.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.9.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.10 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascias by expansion and contraction joints spaced not more than 12 feet apart.

3.1.11 Base Flashing

Lay the base flashings with each course of the roof covering, shingle fashion, where practicable, where sloped roofs abut chimneys, curbs, walls, or other vertical surfaces. Extend up vertical surfaces of the flashing not less than 8 inch and not less than 4 inch under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inch. Overlap the flashing strips or shingles with the previously laid flashing not less than 3 inch. Fasten the strips or shingles at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inch on center with large headed aluminum roofing nails, hex headed, galvanized shielded screws a minimum of 2-inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of chimneys, curbs, and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inch at the lower side of dormer walls, chimneys, and similar vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

3.1.12 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inch above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inch. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inch by 8 inch, 8 inch by 10 inch, or may be of the preformed one-piece type. Provide end laps in counterflashings not less than 3 inch and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12 inch from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inch apart; on chimneys and stair/elevator towers short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inch into the walls. Install counterflashing to provide a spring action against base flashing. Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.

3.1.13 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 1/4 inch and a depth of 1 1/4 inch, as approved.

3.1.13.1 Caulked Reglets

Provide with rounded edges and metal strap brackets or other anchors for securing to the concrete forms. Provide reglets with a core to protect them from injury during the installation. Provide built-up mitered corner pieces for internal and external angles. Wedge the flashing in the reglets with lead wedges every 18 inch, caulked full and solid with an approved compound.

3.1.13.2 Friction Reglets

Provide with flashing receiving slots not less than 5/8 inch deep, one inch jointing tongues, and upper and lower anchoring flanges installed at 24 inch maximum snaplock receiver. Insert the flashing the full depth of the slot and lock by indentations made with a dull-pointed tool, wedges, and filled with a sealant. For friction reglets, install flashing snaplock receivers at 24 inch on center maximum. When the flashing has been inserted the full depth, caulk the slot and lock with wedges and fill with sealant.

3.1.14 Polyvinyl Chloride Reglets Temporary Construction Installation

Rigid polyvinyl chloride reglets ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness may be provided in lieu of metal reglets for temporary construction.

3.1.15 Gravel Stops and Fascias

Prefabricate in the shapes and sizes indicated and in lengths not less that 8 feet. Extend flange at least 4 inch onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascias after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascias on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in.Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inch long spaced not more than 3 inch on center, in two staggered rows.

3.1.15.1 Edge Strip

Hook the lower edge of fascias at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inchmaximum on center. Where fastening is made to concrete or masonry, use screws spaced 12 inch on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

3.1.15.2 Joints

Leave open the section ends of gravel stops and fascias 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inch set laps in plastic cement. Face

nailing will not be permitted. Install prefabricated aluminum gravel stops and fascias in accordance with the manufacturer's printed instructions and details.

3.1.16 Metal Drip Edge

Provide a metal drip edge, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 3 inch and secure with compatible nails spaced not more than 10 inch on center along upper edge.

3.1.17 Gutters

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 8 feet. Lap the sections a minimum of one inch in the direction of flow or provide with concealed splice plate 6 inch minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on adjustable hangers spaced not more than 30 inch on center, as indicated, by continuous cleats, and or by cleats spaced not less than 36 inch apart. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals.

3.1.18 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the wood, masonry, or steel substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.18.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.1.19 Flashing for Roof Drains

Provide a 30 inch square sheet indicated. Taper insulation to drain from 24 inch out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D 4586. Heavily coat the drain flashing ring with asphalt

roof cement. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing are free of wrinkles and folds. Retrofit roof drains must conform to ANSI/SPRI RD-1.

3.1.20 Scuppers

Line interior of scupper openings with sheet metal. Extend the lining through and project outside of the wall to form a drip on the bottom edge and form to return not less than one inch against the face of the outside wall at the top and sides. Fold outside edges under 1/2 inch on all sides. Provide the perimeter of the lining approximately 1/2 inch less than the perimeter of the scupper. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement.

3.1.21 Conductor Heads

Type indicated and fabricated of the same material as the downspouts. Set the depth of top opening equal to two-thirds of the width. Provide outlet tubes not less than 4 inch long. Flat-lock solder the seams. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 2 inch wider than the scupper. Attach conductor heads to the wall with masonry fasteners, and loose-lock to provide conductor heads with screens of the same material. Securely fasten screens to the heads.

3.1.22 Splash Pans

Install splash pans where downspouts discharge on roof surfaces and at other locations as indicated. Unless otherwise shown, provide pans not less than 24 inch long by 18 inch wide with metal ribs across the bottom of the pan. Form the sides of the pan with vertical baffles not less than one inch high in the front, and 4 inch high in the back doubled over and formed continuous with horizontal roof flanges not less than 4 inch wide. Bend the rear flange of the pan to contour of cant strip and extend up 6 inch under the side wall covering or to height of base flashing under counterflashing. Bed the pans and roof flanges in plastic bituminous cement and strip-flash as specified.

3.1.23 Open Valley Flashing

Provide valley flashing free of longitudinal seams, of width sufficient to extend not less than 6 inch under the roof covering on each side. Provide a 1/2 inch fold on each side of the valley flashing. Lap the sheets not less than 6 inch in the direction of flow and secure to roofing construction with cleats attached to the fold on each side. Nail the tops of sheets to roof sheathing. Space the cleats not more than 12 inch on center. Provide exposed flashing not less than 4 inch in width at the top and increase one inch in width for each additional 8 feet in length. Where the slope of the valley is 4.5 inch or less per foot, or the intersecting roofs are on different slopes, provide an inverted V-joint, one inch high, along the centerline of the valley; and extend the edge of the valley sheets 8 inch under the roof covering on each side.

Valley flashing for asphalt shingle roofs is specified in SECTION 07 31 13 ASPHALT SHINGLES

3.1.24 Eave Flashing

One piece in width, applied in 8 to 10 foot lengths with expansion joints spaced as specified in paragraph entitled "Expansion and Contraction." Provide a 3/4 inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 10 inch on center. Locate the upper edge of flashing not less than 18 inch from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with one inch flat locked joints with cleats that are 10 inch on center.

3.1.25 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 16 by 18 inch. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.1.26 Expansion Joints

Provide expansion joints for roofs, walls, and floors as specified, indicated. Provide expansion joints in continuous sheet metal at 40 foot intervals for copper and stainless steel and at 32 foot intervals for aluminum, aluminum gravel stops and fascias which must have expansion joints at not more than 12 foot spacing. Provide evenly spaced joints. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing. Conform to the requirements of Table I.

3.1.26.1 Roof Expansion Joints

Consist of curb with wood nailing members on each side of joint, bituminous base flashing, metal counterflashing, and metal joint cover. Bituminous base flashing is specified in Roofing Section. Provide counterflashing as specified in paragraph "Counterflashing," except as follows: Provide counterflashing with vertical leg of suitable depth to enable forming into a horizontal continuous cleat. Secure the inner edge to the nailing member. Make the outer edge projection not less than one inch for flashing on one side of the expansion joint and be less than the width of the expansion joint plus one inch for flashing on the other side of the joint. Hook the expansion joint cover over the projecting outer edges of counterflashing. Provide roof joint with a joint cover of the width indicated. Hook and lock one edge of the joint cover over the shorter projecting flange of the continuous cleat, and the other edge hooked over and loose locked with the longer projecting flange. . Joints are specified in Table II.

3.1.26.2 Floor and Wall Expansion Joints

Provide U-shape with extended flanges for expansion joints in concrete and masonry walls and in floor slabs.

3.1.27 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck. Goose-necks, rainhoods, power roof ventilators, and _____ are specified in _____.

3.1.28 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 3 inch on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inch. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inch roof flange in bituminous plastic cement and nailed 3 inch on center. Extend sleeve a minimum of8 inch above the roof deck and lapped a minimum of 3 inch by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.1.29 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.1.30 Copings

Provide coping using copper sheets 8 or 10 feet long joined by a 3/4 inch locked and soldered seam. . Terminate outer edges in edge strips. Install with sealed lap joints, cover plate joints, standing seam joints as indicated.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials.

3.2.1 Aluminum Surfaces

Shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in

conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage
Building Expansion Joints					
Cover	16	.032	.015	.015	24
Waterstop-bellows or flanged, U-type	16	-	.015	.015	-
Covering on minor flat, pitched or curved surfaces	20	.040	.018	.018	-
Downspouts and leaders	16	.032	.015	.015	24
Downspout clips and anchors	-	.040 clip	-	-	-
	-	.125 anchor	-	-	-
Downspout straps, 2-inch	48(a)	.060	.050	-	-
Conductor heads	16	.032	.015	.015	-
Scupper lining	20	.032	.015	.015	-
Strainers, wire diameter or gage	No. 9 gage	.144 diameter	.109 diameter		-
Flashings:					
Base	20	.040	.018	.018	24
Cap (Counter-flashing)	16	.032	.015	.015	26
Eave	16	-	.015	.015	24
Spandrel beam	10	-	.010	.010	-
Bond barrier	16	-	.015	.015	-
Stepped	16	.032	.015	.015	-
Valley	16	.032	.015	.015	-

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage
Roof drain.....	16(b)				
Pipe vent sleeve(d)					
Coping.....	16	-	-	-	-
Gravel stops and fascias:					
Extrusions.....	-	.075	-	-	-
Sheets, corrugated.....	16	.032	.015	.015	-
Sheets, smooth.....	20	.050	.018	.018	24
Edge strip.....	24	.050	.025	-	-
Gutters:					
Gutter section.....	16	.032	.015	.015	24
Continuous cleat.....	16	.032	.015	.015	24
Hangers, dimensions.....	1 inch x 1/8 inch (a)	1 inch x .080 inch (c)	1 inch x .037 inch	-	-
Joint Cover plates... (See Table II)	16	.032	.015	.015	24
Reglets (c).....	10	-	.010	.010	-
Splash pans.....	16	.040	.018	.018	-

(a) Brass.

(b) May be lead weighing 4 pounds per square foot.

(c) May be polyvinyl chloride.

(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph entitled "Single Pipe Vents" for optional material.

TABLE II. SHEET METAL JOINTS

Item Designation	TYPE OF JOINT: Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	TYPE OF JOINT: Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at	1.25 inch single lock, standing seam, cleated	1.25 inch single lock, standing	- - -

TABLE II. SHEET METAL JOINTS

Item Designation	TYPE OF JOINT: Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
roof			
Flashings			
Base	One inch 3 inch lap for expansion joint	One inch flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum producer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound compound.
Cap-in reglet	3 inch lap	3 inch lap	Seal groove with joint sealing compound.
Reglets	Butt joint	- - -	Seal reglet groove with joint sealing compound.
Eave	One inch flat locked, cleated One inch loose locked, expansion joint cleated	One inch flat locked, locked, cleated one inch loose locked, sealed expansion joints, cleated	Same as base flashing.
Stepped	3 inch lap	3 inch lap	- - -
Valley.	6 inch lap cleated	6 inch lap cleated	- - -
Edge strip	Butt	Butt	- - -
Gravel stops:			
Extrusions	- - -	Butt with 1/2 inch space	Use sheet flashing beneath and a cover plate.
Sheet, smooth	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing backup plate.
Sheet	Butt with 1/4 inch	Butt with 1/4 inch	Use sheet flashing

TABLE II. SHEET METAL JOINTS

Item Designation	TYPE OF JOINT: Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	TYPE OF JOINT: Aluminum	Remarks
corrugated	space	space	beneath and a cover plate or a combination unit
Gutters	1.5 inch lap, riveted and soldered	One inch flat locked, riveted, and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.

(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.

(b) Seal polyvinyl chloride reglet with manufacturer's recommended sealant.

-- End of Section --

SECTION 07 61 00

SHEET METAL AND CLADDING

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-07 Certificates

Exposed Sheet Metal Items

Fasteners

Aluminum Alloy Sheet and Plate

Finish

Manufacturer's certificates attesting that materials meet specified requirements

1.3 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Furnish sheet metal items in 8-to 10-foot lengths. Single pieces less than

8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to a thickness of 0.032-inch. Sheet metal items shall have mill finish unless specified otherwise.

2.1.1 Exposed Sheet Metal Items

Shall be of the same material. The following items shall be considered as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascias; cap, valley, steeped, base, and eave flashings and related accessories.

2.1.2 Aluminum Alloy Sheet and Plate

ASTM B 209, Alclad 3003, Alclad 3004, or Alclad 3005, embossed finish, clad on one side unless indicated otherwise; temper appropriate to end use. Thickness 0.040 inches.

2.1.2.1 Finish

Exposed exterior sheet metal items of aluminum shall have a baked-on, factory-applied color coating of polyvinylidene fluoride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be 0.8 to 1.3 mils and color shall be as directed.

2.1.2.2 Fasteners

The same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Requirements

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of the SMACNA Arch. Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight.

3.1.2 Workmanship

Make lines, arrises, and angles sharp and true. Free exposed surfaces from visible wave, warp, and buckle, and tool marks. Fold back exposed edges neatly to form a 1/2-inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

3.1.3 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum

width of 18 inches. Confine nailing or flashing to one edge only. Space nails evenly not over 3 inches on centers and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.

3.1.4 Cleats

Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on centers unless otherwise specified or indicated. Unless otherwise specified, cleats shall be not less than 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Pretin cleats for soldered seams.

3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection.

3.1.6 Edges

Seal joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.7 Protection from Contact with Dissimilar Materials

3.1.7.1 Aluminum

Aluminum surfaces shall not directly contact other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.1.7.2 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.7.3 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.2 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fit tings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.3 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as

approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

-- End of Section --

SECTION 07 62 00

METAL EDGE STRIP

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4022	(1994) Coal Tar Roof Cement, Asbestos Containing
ASTM D 4586	(1993; R 1999) Asphalt Roof Cement, Asbestos Free

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS UU-B-790	(Rev. A; Notice 2) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellant, and Fire Resistant)

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Edge strip

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.3 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid

damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Furnish sheet metal items in 8-to 10-foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Sheet metal items shall have mill finish unless specified otherwise.

2.1.1 Finish

Exposed exterior items of zinc-coated steel sheet shall have a baked-on, factory-applied color coating of polyvinylidene fluoride or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be 0.8 to 1.3 mils and color shall be as indicated.

2.1.2 Bituminous Plastic Cement

ASTM D 4586, Type I; ASTM D 4022.

2.1.3 Building Paper

FS UU-B-790, Style 4, Grade B.

2.1.4 Asphalt Primer

ASTM D 41.

2.1.5 Through-Wall Flashing

Through-wall flashing for masonry is specified in Section 04 20 00, "Masonry."

2.1.6 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Requirements

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA Arch. Manual, Architectural Sheet Metal Manual.

3.1.2 Workmanship

Make lines, arrises, and angles sharp and true. Free exposed surfaces from visible wave, warp, and buckle, and tool marks. Fold back exposed edges neatly to form a 1/2-inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

3.1.3 Edge Strip

Hook the lower edge of fascias at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on centers. Where fastening is made to concrete or masonry, use screws spaced 12 inches on centers driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16-inch thick compatible spacer or washers.

-- End of Section --

SECTION 07 72 00

ROOF RIDGE VENTILATORS, GRAVITY-TYPE

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1998) Minimum Design Loads for Buildings and Other Structures

1.2 DESIGN REQUIREMENTS

The ventilators shall be of the ridge type, constructed of aluminum-alloy or zinc-coated steel, and the product of a manufacturer regularly engaged in the manufacture of roof ventilators. The ventilators shall be of the sizes indicated and shall be furnished complete with bases, flashing flanges, and bird screens. The ventilators shall be weatherproof and shall be free from back draft except in the event of interior negative pressure. The design shall be such that the ventilators will be capable of self-cleaning by the action of the elements with provision for carrying water and normal wind-transported soil matter to the outside. The ventilators shall be designed for wind loads in accordance with ASCE 7, but in no case shall the installed design be for less than 100 mph wind load. The structural bracing shall be properly spaced to accommodate this loading and in accordance with the design requirements of the covering material. Ridge type ventilators shall be equipped with wind jump diaphragms spaced at each structural frame to afford efficient ventilation regardless of wind direction.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-03 Product Data

Ventilators

PART 2 PRODUCTS

2.1 FABRICATION

Ventilators shall be adequately reinforced and well braced with joints properly formed. Edges shall be wired or beaded, where necessary, to insure rigidity. Galvanic action between different metals in direct contact shall be prevented by nonconductive separators. All soldering shall be even and smooth. Ridge ventilators shall be constructed in sections suitable for shipment and installation. Joints between sections

shall be made in such manner as to be waterproof and properly allow for expansion and contraction. Suitable end fittings shall be provided for each continuous run of ventilator.

2.1.1 Bases

The base provided with the ventilators shall be factory-formed of the type indicated and shall be of the same material as the hoods, and shall be of a thickness necessary to meet the design requirements specified herein. Bases shall be provided with flashing flanges extending over the adjoining roof surfaces a sufficient distance to provide for proper connection with the roof.

2.1.2 Finish

Finish exterior sheet metal items of aluminum or galvanized steel shall have baked-on factory-applied color coating of polyvinylidene fluoride (PVC2) or other equivalent fluorocarbon coating appllied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be 0.8 to 1.3 mils. Color shall be flat black.

2.1.3 Screens

Screens shall be provided with frames of the same material as the material used in the ventilators and shall be securely attached in such manner as to permit easy removal for cleaning on the roof. Screens for ridge ventilators shall be in sections to match ventilator sections, with cross members of frames flanged for bolted connections.

PART 3 EXECUTION

3.1 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods:

a. Paint: Aluminum surfaces to be protected shall be solvent cleaned and given a coat of zinc-chromate primer and one coat of aluminum paint.

b. Nonabsorptive Tape or Gasket: Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and shall be cemented to the aluminum surface using a cement compatible with aluminum.

3.2 INSTALLATION

Unless otherwise indicated, all equipment shall be installed in accordance with the manufacturer's recommendations. Anchors, attachments, and other items to be built-in shall be coordinated for installation as the work progresses. Ventilators shall be rigidly installed and free from vibration due to wind. Connection to the building structure shall provide a watertight connection.

-- End of Section --

SECTION 07 84 00

FIRESTOPPING
10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 119	(2007a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1399	(1997; R 2005) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	(2007) Fire-Resistive Joint Systems
ASTM E 814	(2006) Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM AS 4991	(2001) Approval of Firestop Contractors
FM P7825a	(2005) Approval Guide Fire Protection

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003; Rev thru Apr 2007) Standard for Fire Tests of Through-Penetration Fire Stops
UL 2079	(2004; Mar 2006) Tests for Fire Resistance of Building Joint Systems
UL 723	(2003; Rev thru May 2005) Standard for Test for Surface Burning Characteristics of Building Materials
UL Fire Resistance	(2007) Fire Resistance Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials.

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" and "T" ratings, and type of application.

SD-07 Certificates

Firestopping Materials.

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications.

Documentation of training and experience.

Inspection.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

1.4 DELIVERY AND STORAGE

Materials shall be delivered in the original unopened packages or

containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is:

a. FM Research approved in accordance with FM AS 4991, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free, noncombustible products FM P7825a approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application or during fire conditions.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM P7825a approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected, except that "F" rating may

be 3 hours in through-penetrations of 4 hour fire rated wall or floor. Firestop systems shall also have "T" rating where required.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.

b. Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the ceiling membrane of Roof-Ceiling Assemblies: F Rating = Rating of wall or partition being penetrated.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur, as follows: construction joints in walls, same rating as floor; construction joints in floors, same rating as walls; gaps between floor slabs and curtain walls, same rating as floor; gaps between top of the walls and the bottom of roof and floor decks, same rating as floor hour. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device. Surfaces shall be prepared as recommended by the manufacturer.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Fire dampers shall be installed and firestopped in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products that do not cure over time. Firestopping shall be modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, adds or changes without the need to remove or replace any firestop materials.

3.3 INSPECTION

For Navy projects, install one of each type of penetration and have it inspected and accepted by the Naval Facilities Engineering Command, Fire Protection Engineer prior to the installation of the remainder of the penetrations. At this inspection, the manufacturer's technical representative of the firestopping material shall be present. For all projects, the remainder of, the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the manufacturer's technical representative. The manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. The Contractor shall submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 734	(2006) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(2005) Latex Sealants
ASTM C 919	(2002) Use of Sealants in Acoustical Applications
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 217	(2002) Cone Penetration of Lubricating Grease
ASTM D 2452	(2003) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D 2453	(2003) Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material Safety Data Sheet for each solvent, primer or sealant material.

SD-07 Certificates

Sealant

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Lable elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

1.5 QUALITY ASSURANCE

1.5.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

1.5.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.5.3 Mock-Up

Project personnel is responsible for installing sealants in mock-up prepared by other trades, using materials and techniques approved for use on the project.

1.6 SPECIAL WARRANTY

Guarantee sealant joint against failure of sealant and against water penetration through each sealed joint for five years.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

Provide ASTM C 834, ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) and color(s) of sealant for the following:

	LOCATION	COLOR
a.	Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	As indicated
b.	Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	As indicated
c.	Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	As indicated
d.	Joints between edge members for acoustical tile and adjoining vertical surfaces.	As indicated
e.	Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As indicated
f.	Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	As indicated
g.	Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occuring where substrates change.	As indicated
h.	Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	As indicated

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

	LOCATION	COLOR
a.	Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or	As indicated

	LOCATION	COLOR
	metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	
b.	Joints between new and existing exterior masonry walls.	As indicated
c.	Masonry joints where shelf angles occur.	As indicated
d.	Joints in wash surfaces of stonework.	As indicated
e.	Expansion and control joints.	As indicated
f.	Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	As indicated
g.	Voids where items pass through exterior walls.	As indicated
h.	Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	As indicated
i.	Metal-to-metal joints where sealant is indicated or specified.	As indicated
j.	Joints between ends of gravel stops, fascias, copings, and adjacent walls.	As indicated

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

	LOCATION	COLOR
a.	Seats of metal thresholds for exterior doors.	As indicated
b.	Control and expansion joints in floors, slabs, ceramic tile, and walkways.	As indicated

2.1.4 Acoustical Sealant

Rubber or polymer-based acoustical sealant conforming to ASTM C 919 must have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant must have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and must be non-staining.

2.1.5 Preformed Sealant

Provide preformed sealant of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of

sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant must be non-bleeding and no loss of adhesion.

2.1.5.1 Foam Strip

Provide 1/4 inch foam strip of polyurethane foam; with cross-section dimensions of 5/16 inch. Provide foam strip capable of sealing out moisture, air, and dust when installed and compressed as recommended by the manufacturer. Service temperature must beminus 40 to plus 275 degrees F. Furnish untreated strips with adhesive to hold them in place. Do not allow adhesive to stain or bleed into adjacent finishes. Saturate treated strips with butylene waterproofing or impregnated with asphalt.

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.4.1 Rubber

Conform to ASTM D 1056, Type 1, open cell, or Type 2, closed cell, Class A, Grade 1, round cross section for cellular rubber sponge backing.

2.4.2 Synthetic Rubber

Conform to ASTM C 509, Option I, II, Type I, II preformed rods or tubes for Synthetic rubber backing.

2.5 CAULKING

Conform to ASTM D 2452 and ASTM D 2453.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion.

Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.1.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, or stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
Over 1/2 inch to 2 inch	1/2 inch	5/8 inch
Over 2 inch.	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the

sealant when and as specified by the sealant manufacturer.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 879/A 879M	(2006) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A 924/A 924M	(2007) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 578	(2007) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2007) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2004) Mineral Fiber Block and Board Thermal Insulation
ASTM D 2863	(2006a) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A115	(2006)(Complete Set - Spec dates Vary) Specifications for Door and Frame Preparation for Hardware (Incl A115.1 (1990), A115.2 (1987), A115.4 (1994), A115.5 (1992), A115.6 (1993), A115.12

(1994), A115.13 (1991), A115.14 (1994), A115.15 (1994), A115.16 (1990), A115.17 (1994), A115.18 (1994)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA HMM (1999; R2000) Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105 (2006; Errata 2007; Errata 2007) Installation of Smoke Door Assemblies

NFPA 252 (2007) Standard Methods of Fire Tests of Door Assemblies

NFPA 80 (2007) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDOI)

SDI/DOOR 111 (2000) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories

SDI/DOOR 113 (2001) Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies

SDI/DOOR A250.11 (2001) Recommended Erection Instructions for Steel Frames

SDI/DOOR A250.6 (2003) Hardware on Steel Doors (Reinforcement - Application)

SDI/DOOR A250.8 (2003) Recommended Specification for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 10B (1997; Rev thru Oct 2001) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Doors

Frames

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware

provisions, method of glazing, and installation details.

Schedule of doors

Schedule of frames

Submit door and frame locations.

SD-03 Product Data

Doors

Frames

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knock-down frames in bundles. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

2.1.1 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 1, 2, with core construction as required by the manufacturer for interior doors and for exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level 2 where indicated, for doors No. _____.

2.2 CUSTOM HOLLOW METAL DOORS

Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Door size(s), design(s), materials, construction, gages, and finish shall be as specified for

standard steel doors and shall comply with the requirement of NAAMM HMMA HMM. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 16 gage. Close tops of exterior doors flush with an additional channel and seal to prevent water intrusion. Prepare doors to receive hardware specified in Section 08 71 00 DOOR HARDWARE. Undercut doors where indicated. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

2.3 SOUND RATED STEEL DOORS

Doors shall be of the sound classification scheduled on Drawing Sheet No. _____.

2.4 ACCESSORIES

2.4.1 Shelves for Dutch Doors

SDI/DOOR 111. Fabricate shelves of steel not lighter than 16 gage, _____ inches wide, of the size indicated. Brackets shall be stock type fabricated of the same metal used to fabricate shelves.

2.4.2 Louvers

2.4.2.1 Interior Louvers

SDI/DOOR 111, Louvers shall be stationary sightproof and lightproof type where scheduled. Louvers for lightproof doors shall not transmit light. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage. Louvers for lightproof doors shall have minimum of 20 percent net-free opening. Sightproof louvers to be inverted "V" blade design with minimum 55 and inverted "Y" blade design with minimum 40 percent net-free opening.

2.4.2.2 Exterior Louvers

Louvers shall be inverted "Y", "V", "Z" type with minimum of 30, 55, 35 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect, bird screens secured to room side and readily removable. Provide aluminum wire cloth, 18 by 18 or 18 by 16 inch mesh, for insect screens, galvanized steel, 1/2 by 1/2 inch mesh hardware cloth, for bird screens. Net-free louver area to be before screening.

2.4.3 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors. For interior pairs of fire rated and smoke control doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies and NFPA 105 for smoke control assemblies.

2.4.4 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary

or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.5 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and shall conform to:

a. Rigid Polyurethane Modified Polyisocyanurate Foam: ASTM C 591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or

b. Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or

c. Mineral board: ASTM C 612, Type I.

2.6 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 1, 2, 3, 4, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners. Provide steel frames for doors, transoms, sidelights, mullions, cased openings, and interior glazed panels, unless otherwise indicated.

2.6.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.6.2 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

2.6.3 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto or knock-down for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.6.4 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.6.5 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.6.5.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to wood studs with nails, to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

d. Solid plaster partitions: Secure anchors solidly to back of frames and tie into the lath. Provide adjustable top strut anchors on each side of frame for fastening to structural members or ceiling construction above. Size and type of strut anchors shall be as recommended by the frame manufacturer.

2.6.5.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.7 FIRE AND SMOKE DOORS AND FRAMES

NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

2.7.1 Door and Frame Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.7.2 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

2.8 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.9 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping or lightproof or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.10 FINISHES

2.10.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8, or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.10.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior, interior, scheduled doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924Mand ASTM A 653/A 653M. The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8. Provide for exterior doors and interior doors, door openings No. _____.

2.10.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 879/A 879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.11 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Frames for use in solid plaster partitions shall be welded construction. On wraparound frames for masonry partitions, provide a throat opening 1/8 inch larger than the actual masonry thickness. Design other frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.11.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

SECTION 08 11 16

ALUMINUM DOORS AND FRAMES

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603	(2002) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	(2005) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Structural

Shapes and thicknesses of framing members shall be sufficient to withstand a design wind load of not less than 30 kPa pounds per square foot of supported area, the design wind load indicated with a deflection of not

more than 1/175 times the length of the member and a safety factor of not less than 1.65. Provide glazing beads, moldings, and trim of not less than 0.050 inch nominal thickness.

1.2.2 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed 0.06 cubic feet per minute per square footof fixed area at a test pressure of 6.24 pounds per square foot (50 mile per hour wind).

1.2.3 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 8 pounds per square foot of fixed area.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Doors and frames

Show elevations of each door type, size of doors and frames, metal gages, details of door and frame construction, methods of anchorage, glazing details, weatherstripping, provisions for and location of hardware, and details of installation.

SD-08 Manufacturer's Instructions

Doors and frames

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on nonabsorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

1.5 FIELD MEASUREMENTS

Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, framing members, subframes, transoms, adjoining sidelights, adjoining window wall, trim, and accessories.

2.2 MATERIALS

2.2.1 Anchors

Stainless steel or steel with hot-dipped galvanized finish.

2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.2.3 Aluminum Alloy for Doors and Frames

ASTM B 221, Alloy 6063-T5 for extrusions. ASTM B 209, alloy and temper best suited for aluminum sheets and strips.

2.2.4 Fasteners

Hard aluminum or stainless steel.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches on center. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Aluminum Doors

Of type, size, and design indicated and not less than 1-3/4 inch thick. Minimum wall thickness, 0.125 inch, except beads and trim, 0.050 inch. Door sizes shown are nominal and shall include standard clearances as follows: 0.093 inch at hinge and lock stiles, 0.125 inch between meeting stiles, 0.125 inch at top rails, 0.187 inch between bottom and threshold, and 0.687 inch between bottom and floor. Bevel single-acting doors 0.063 or 0.125 inch at lock, hinge, and meeting stile edges. Double-acting doors shall have rounded edges at hinge stile, lock stile, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Doors shall have narrow, medium, wide stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 3/8 or 1/2 inch diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.3.2.2 Flush Doors

Use facing sheets with a vertical ribbed, an embossed or a plain smooth surface. Use one of the following constructions:

a. Form from extruded aluminum members at top and bottom, both sides, and at perimeters of louver and glass cutouts. Wall sections of

extruded aluminum members shall be not less than 0.09 inch thick and be properly reinforced for application of hardware. Framing members shall be covered on both sides with aluminum facing sheets not less than 0.064 inch thick. Fill door with foamed-in urethane with a 3 pound density.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weatherstripped door shall not exceed 0.5, 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

2.3.5 Anchors

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Where indicated, reinforce vertical mullions with structural steel members of sufficient length to extend up to the overhead structural slab or framing and secure thereto. Reinforce and anchor freestanding door frames to floor construction as indicated on approved shop drawings and in accordance with manufacturer's recommendation. Place anchors as indicated, near top and bottom of each jamb and at intermediate points not more than 25 inch apart.

2.3.6 Provisions for Hardware

Coordinate with Section 08 71 00 DOOR HARDWARE. Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws. Provide reinforcement in core of flush doors as required to receive locks, door closers, and other hardware.

2.3.7 Provisions for Glazing

Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified.

2.3.8 Finishes

Provide exposed aluminum surfaces with mill finish, factory finish of anodic coating or organic coating.

2.3.8.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45. Finish shall be clear (natural), designation AA-M10-C22-A31, Architectural Class II 0.4 mil to 0.7 mil, clear (natural), designation AA-M10-C22-A41, Architectural Class I 0.7 mil or thicker), integral color-anodized, designation AA-M10-C22-A32, Architectural Class II 0.4 mil to 0.7 mil, integral color-anodized, designation AA-M10-C22-A42, Architectural Class I 0.7 mil or thicker, electrolytically deposited color-anodized, designation AA-M10-C22-A34, Architectural Class II 0.4 mil to 0.7 mil, electrolytically deposited color-anodized, designation AA-M10-C22-A44, Architectural Class I 0.7 mil or thicker. Color shall be as indicated.

2.3.8.2 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a baked enamel finish in accordance with AAMA 2603 with total dry film thickness not less than 0.8 mil, a high-performance finish in accordance with AAMA 2604 with total dry film thickness of not less than 1.2 mils. The finish color shall be as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors, transoms, adjoining sidelights, and, adjoining window walls. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions. Anchor bottom of each frame to rough floor construction with 3/32 inch thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Hang doors to produce clearances specified in paragraph entitled "Aluminum Doors," of this section. After erection and glazing, adjust doors and hardware to operate properly.

3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact to dissimilar metals.

3.2.1.1 Protection

Provide one of the following systems to protect surfaces in contact with dissimilar metals:

a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply a good quality elastomeric sealant between the aluminum and

the dissimilar metal.

c. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.

d. Use a nonabsorptive tape or gasket in permanently dry locations.

3.2.2 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.3 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

3.3 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's written recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.4 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

-- End of Section --

SECTION 08 14 00

WOOD DOORS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(8th Edition) AWI Quality Standards

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 2074	(2000e1) Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	(2007) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997; Rev thru Oct 2001) Fire Tests of Door Assemblies

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1997) Architectural Wood Flush Doors

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Doors

Submit drawings or catalog data showing each type of door unit; descriptive data of head and jamb weatherstripping with installation instructions shall be included. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly, door louvers, and glazing,.

SD-03 Product Data

Doors

Accessories

Water-resistant sealer

Sample warranty

Sound transmission class rating

Fire resistance rating

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inch thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

1.4 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs indicated, specified.

2.1.1 Flush Doors

Conform to WDMA I.S. 1-A for flush doors. Provide hollow core doors with lock blocks and 1 inch minimum thickness hinge stile. Hardwood stile edge bands of doors receives a natural finish, compatible with face veneer. Provide mill option for stile edge of doors scheduled to be painted. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.

2.1.1.1 Exterior Flush Doors

Solid wood core, Type I conforming to WDMA I.S. 1-A. Provide doors with tempered hardboard, medium density overlayed hardwood veneer faces.

Provide wood edge bands. Install in exterior flush doors with aluminum, bronze, copper flashings at the bottom of the openings.

2.1.1.2 Interior Flush Doors

Provide staved lumber, particleboard, hollow core, Type II flush doors conforming to WDMA I.S. 1-A with faces of sound grade hardwood or hardboard for painted finish, premium, good grade natural birch, select premium white, red, birch, premium, good grade red, white, oak, premium, good grade walnut, plastic laminate. Hardwood veneers shall be rotary cut, plain sliced, quarter sliced, random, slip, book, matched. Finish plastic laminate faced doors on both vertical edges with wood, laminated plastic, of color matching faces.

2.1.2 Composite-Type Fire Doors

Provide doors specified or indicated to have a fire resistance rating conforming to the requirements of UL 10B, ASTM E 2074, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.

2.1.3 Prehung Doors

Frames for prehung interior doors to be for painted, clear, finish, with 3 piece adjustable jamb units, 3 piece adjustable jamb units with pins. Provide doors complete with frame, hinges, and prepared to receive finish hardware.

2.2 ACCESSORIES

2.2.1 Door Louvers

Fabricate from wood and of sizes indicated. Provide louvers with a minimum of 35 percent free air. Equip louvers with slat, sightproof inverted vee slat type. Block hollow core doors to provide solid anchorage for the louvers. Mount louvers in the door with flush wood moldings, wood lip moldings.

2.2.2 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings. Provide moldings for doors to receive natural finish of the same wood species and color as the wood face veneers. Provide moldings on the exterior doors with sloped surfaces. Lip type moldings for flush doors.

2.2.3 Weatherstripping

Provide weatherstripping that is a standard cataloged product of a manufacturer regularly engaged in the manufacture of this specialized item. Provide weatherstripping tempered spring bronze or looped neoprene or vinyl held in an extruded non-ferrous metal housing. Install bronze weatherstripping with a minimum thickness of 0.0089 inch for sills, and a minimum thickness of 0.0063 inch elsewhere. Air leakage of weatherstripped doors not to exceed 0.5, 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

2.2.4 Additional Hardware Reinforcement

Provide the minimum lock blocks to secure the specified hardware. The measurement of top, bottom, and intermediate rail blocks are a minimum 125 mm 5 inch by full core width. Comply with the manufacturer's labeling requirements for reinforcement blocking, but not mineral material similar to the core.

2.3 FABRICATION

2.3.1 Marking

Stamp each door with a brand, stamp, or other identifying mark indicating quality and construction of the door.

2.3.2 Adhesives and Bonds

WDMA I.S. 1-A. Use Type I bond for exterior doors and Type II bond for interior doors. Provide a nonstaining adhesive on doors with a natural finish.

2.3.3 Prefitting

Provide factory prefinished, finished, and factory prefitted doors for the specified hardware, door frame and door-swing indicated. Machine and size doors at the factory by the door manufacturer in accordance with the standards under which the doors are produced and manufactured. The work includes sizing, bevelling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules to coordinate the work.

2.3.4 Finishes

2.3.4.1 Field Painting

Factory prime or seal doors, and field paint.

2.3.4.2 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: AWI Qual Stds Section 1500, specification for System No. 4 Conversion varnish alkyd urea or System No. 5 Vinyl catalyzed. The coating is AWI Qual Stds premium, medium rubbed sheen, open, closed grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

2.3.4.3 Plastic Laminate Finish

Factory applied, NEMA LD 3, General or Specific purpose type, 0.050 inch minimum thickness. Glue laminated plastic for hollow core doors to wood veneer, plywood, or hardboard backing to form door panel. Provide a combined thickness of laminate sheet and backing of 0.10 inch minimum.

2.3.5 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finishes.

PART 3 EXECUTION

3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/16 inch minimum, 1/4 inch maximum clearance over thresholds. Provide 3/8 inch minimum, 7/16 inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inch. Door warp shall not exceed1/4 inch when measured in accordance with WDMA I.S. 1-A.

3.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Do not paint over labels.

3.1.2 Prehung Doors

Install doors in accordance with the manufacturer's instructions and details. Provide fasteners for stops and casing trim within 3 inch of each end and spaced 11 inch on center maximum. Provide side and head jambs joined together with a dado or notch of 3/16 inch minimum depth.

3.1.3 Weatherstripping

Install doors in strict accordance with the door manufacturer's printed installation instructions and details. Weatherstrip exterior swing-type doors at sills, heads and jambs to provide weathertight installation. Apply weatherstripping at sills to bottom rails of doors and hold in place with a brass or bronze plate. Apply weatherstripping to door frames at jambs and head. Shape weatherstripping at sills to suit the threshold. Meeting stiles of exterior double-doors shall be made weathertight by means of a looped vinyl or neoprene strip in an extruded nonferrous metal housing applied to the edge of one door leaf, a neoprene, vinyl or spring-bronze weatherstripped astragal secured to the inactive door leaf.

-- End of Section --

SECTION 08 33 13

METAL ROLLING COUNTER DOORS

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 240/A 240M	(2007e1) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

1.2 SUBMITTALS

Submit the followingin accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Detail drawings as specified.

SD-03 Product Data

Rolling Counter Doors

Manufacturer's descriptive data and catalog cuts.

Installation
Cleaning

Manufacturer's preprinted installation and cleaning instructions.

SD-10 Operation and Maintenance Data

Rolling Counter Door (Non-Rated)
Fire-Rated Rolling Counter Door

Six complete copies of Data Package 2 for Rolling Counter Doors (Non-Rated) and Fire-Rated Rolling Counter Doors in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service.

1.3 GENERAL REQUIREMENTS

Furnish rolling counter doors of the type, size, and design indicated on the drawings. Provide the standard product of a manufacturer regularly engaged in the production of rolling counter doors. Provide each door with a permanent label showing the manufacturer's name and address and the model number of the door.

1.4 DETAIL DRAWINGS

Submit drawings showing elevations of each door type, details of anchorage, details of construction, location and description of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings. Include a schedule showing the location of each counter door with the drawings.

1.5 DELIVERY AND STORAGE

Deliver rolling counter doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store rolling counter doors in accordance with the manufacturer's instructions in a dry location that is adequately ventilated and free from dust, water, or other contaminants, and in a manner that permits easy access for inspecting and handling. Handle doors carefully to prevent damage. Replace damaged items that cannot be restored to like-new condition.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 BASIC COMPONENTS

2.1.1 Curtain

Fabricate the curtain of extruded aluminum slats conforming to ASTM B 221, Alloy 6063, 22 gauge Type 304 stainless steel slats conforming to ASTM A 240/A 240M, Type 304 or Type 430 or 22 gauge galvanized steel slats conforming to ASTM A 653/A 653M, Coating Designation G60, G90. Provide thickness of slat material as required by width of opening or as required by specified fire-rating. Use slats approximately 1-1/4 to 1-1/2 inch wide with a depth of crown of 1/2 inch. Fit alternate slats with end locks to maintain curtain alignment. Provide bottom of curtain with angle or

tubular bar reinforcement matching the curtain, and fitted with a resilient bottom seal.

2.1.2 Jamb Guides

Furnish guides of 1/8 inch minimum thickness extruded aluminum conforming to ASTM B 221, Alloy 6063, and fitted with neoprene silencers or replaceable heavy nap striping to eliminate noise and dust infiltration. 13 gauge minimum thickness stainless steel conforming to ASTM A 240/A 240M, Type 304 or Type 430. 13 gauge minimum thickness galvanized steel angles conforming to ASTM A 653/A 653M, Coating Designation G60, G90.

2.1.3 Counterbalance Shaft Assembly

Furnish the curtain coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 0.03 inch per foot. Provide a barrel containing oil tempered helical steel torsion springs capable of sufficient torque to counterbalance the weight of the curtain. Calculate the springs to provide a minimum of 7,500 operating cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position).

2.1.4 Brackets

Furnish brackets of a minimum 12 gauge thickness steel if flat plate, or 16 gauge thickness if there are a minimum of 3 returns of 3/4 inch width.

2.1.5 Hood

Provide a hood of 0.040 inch minimum thickness aluminum sheet conforming to ASTM B 209, Alloy 5005. 24 gauge stainless steel conforming to ASTM A 240/A 240M, Type 304 or Type 430. 24 gauge galvanized steel conforming to ASTM A 653/A 653M, Coating Designation G60, G90.

2.1.6 Locks

Lock the curtain at each side of the bottom bar by an integral slide bolt suitable for padlocks by others, both sides of bottom bar by a chrome-plated cylinder lock keyed into the building keying system. Locate lock on the _____ room side of the counter door. Provide pad locks and keying conforming to Section 08 71 00 DOOR HARDWARE, as shown.

2.2 ROLLING COUNTER DOOR (NON-RATED)

Construct rolling counter doors, curtains, guides and hood components of aluminum, stainless steel, galvanized steel conforming to the requirements specified herein.

2.3 FIRE-RATED ROLLING COUNTER DOOR

Furnish fire-rated rolling counter doors, Class A (3 hr.), Class B (1-1/2 hr.), Class C (3/4 hr.), Class D (1-1/2 hr.) rated, as shown and conforming to the requirements specified and to NFPA 80 for the class indicated. Provide labels of a recognized testing agency for the doors, indicating the applicable fire resistance rating. The construction details necessary for labeled rolling counter doors will take precedence over details indicated or specified herein. Furnish door curtains, guides and hood of stainless steel, galvanized steel. Provide fire-rated rolling counter doors complete with hardware, accessories, and automatic closing device. Provide rolling

counter doors, in exit corridor walls, with perimeter smoke and draft control gasketing.

2.4 INTEGRAL FRAME ROLLING COUNTER DOOR (RATED OR NON-RATED)

Furnish integral frame rolling counter door of aluminum, stainless steel, galvanized steel. Class A (3 hr.), Class B (1-1/2 hr.), Class C (3/4 hr.), Class D (1-1/2 hr.), as shown, stainless steel, galvanized steel. Conform fire-rated doors to the requirements of NFPA 80 for the Class indicated and bearing the labels of a recognized testing agency indicating the applicable fire resistance rating. Form jambs to create guides for the curtain. Provide head and jambs of 16 gauge thickness. Provide counter of 14 gauge thickness. Provide rolling counter doors, in exit corridor walls, with perimeter smoke and draft control gasketing.

2.5 OPERATION

2.5.1 Manual Operation

Provide curtain operated by means of manual push-up with lift handles or continuous full width lift bar, manual crank with removable handle.

2.5.2 Power Operation

Furnish a high-starting torque, reversible type motor of sufficient power and torque output to move the door in either direction from any position at the required speed. Provide power operator with an emergency push-up operation, limit switch, three-button type control marked "OPEN", "CLOSE", and "STOP". Provide control voltage of 24 vac, 120 vac. Provide conduit and wiring necessary for proper operation in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.6 AUTOMATIC CLOSING DEVICE

Equip fire-rated counter doors with an automatic closing device which operates upon the fusing of a 165 degree F fusible link, activation of the building's, fire alarm system, smoke alarm system, heat detector system. Furnish fire and smoke doors that easily reset by the facility user after they have been released by the detection system. Resetting the door must not require the use of special tools.

2.7 FINISH

Exposed parts of the counter door, including the curtain, bottom rail, guides, and hood must be of uniform finish and appearance. Furnish aluminum with a clear anodized finish, stainless steel with a No. 4 finish, steel galvanized coating with a prime coat and a baked-on or powder-coated Factory top coat finish. Give all other steel parts a shop coat of primer paint standard with the manufacturer. Provide a factory coated color in accordance with Section 09 06 90 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Install doors in accordance with approved detail drawings and manufacturer's instructions. Accurately locate anchors and inserts for guides, brackets, hardware, and other accessories. Upon completion, doors shall be free from warp, twist, or distortion. Lubricate, properly adjust,

and demonstrate doors to operate freely. Conform fire-door installation with NFPA 80 for the class indicated and the manufacturer's instructions.

3.2 FIELD FINISHING

Doors to receive field finishing shall be factory primed, as required, and then finished in accordance with Section 09 90 00 PAINTS AND COATINGS. Provide color in accordance with Section 09 06 90 COLOR SCHEDULE.

3.3 CLEANING

Clean aluminum and stainless steel doors in accordance with manufacturer's approved instructions.

3.4 TESTS

Drop-test the fire doors in accordance with NFPA 80 to show proper operation and full automatic closure and reset in accordance with the manufacturer's instructions. Provide a written record of initial test to the Contracting Officer.

-- End of Section --

SECTION 08 34 02

BULLET-RESISTANT COMPONENTS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 611	(1998) Voluntary Specification for Anodized Architectural Aluminum

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 1036	(2006) Standard Specification for Flat Glass
ASTM C 1048	(2004) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 1172	(2003) Standard Specification for Laminated Architectural Flat Glass
ASTM D 1003	(2007) Haze and Luminous Transmittance of Transparent Plastics
ASTM D 1044	(2005) Resistance of Transparent Plastics to Surface Abrasion
ASTM D 3951	(1998; R 2004) Commercial Packaging

ASTM D 4093	(1995; R 2005e1) Photoelastic Measurements of Birefringence and Residual Strains in Transparent or Translucent Plastic Materials
ASTM D 905	(2003) Strength Properties of Adhesive Bonds in Shear by Compression Loading
ASTM E 1300	(2007) Determining Load Resistance of Glass in Buildings
ASTM E 90	(2004) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM F 1233	(1998; R 2004) Security Glazing Materials and Systems
ASTM F 428	(2003a) Intensity of Scratches on Aerospace Glass Enclosures
ASTM F 520	(1997; R 2004) Environmental Resistance of Aerospace Transparencies
ASTM F 521	(1983; R 2004) Bond Integrity of Transparent Laminates
ASTM F 548	(2003ae1) Intensity of Scratches on Aerospace Transparent Plastics
ASTM F 735	(2006) Abrasion Resistance of Transparent Plastics and Coatings Using the Oscillating Sand Method

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(2006) Butts and Hinges
BHMA A156.115	(2006) Hardware Preparation in Steel Doors and Steel Frames
BHMA A156.13	(2005) Mortise Locks & Latches, Series 1000
BHMA A156.16	(2002) Auxiliary Hardware
BHMA A156.18	(2006) Materials and Finishes
BHMA A156.4	(2000) Door Controls - Closers
BHMA A156.5	(2001) Auxiliary Locks & Associated Products
BHMA A156.8	(2005) Door Controls - Overhead Stops and Holders

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2004) Glazing Manual

H.P. WHITE LABORATORY (HPW)

HPW TP-0501.01	(1989) Ballistic Resistance of Structural Materials (Opaque and Transparent); Test Procedures and Acceptance Criteria

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA 810	(1987) Hollow Metal Doors
NAAMM HMMA 820	(1987) Hollow Metal Frames
NAAMM HMMA 830	(2002) Hardware Selection for Hollow Metal Doors and Frames
NAAMM HMMA 840	(1999) Installation and Storage of Hollow Metal Doors and Frames
NAAMM HMMA 850	(2000) Fire Rated Hollow Metal Doors and Frames
NAAMM HMMA 862	(2003) Guide Specifications for Commercial Security Hollow Metal Doors and Frames

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 6	(1993; R 2006) Standard for Industrial Controls and Systems Enclosures
NEMA MG 1	(2007) Standard for Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition
NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

NATIONAL INSTITUTE OF JUSTICE (NIJ)

NIJ Std 0108.01	(1985) Ballistic Resistant Protective Materials

U.S. DEPARTMENT OF STATE (SD)

SD Std-01.01	(1993 Rev G Amended; Inx Certified Prod/Mfg) Certification Standard Forced Entry and Ballistic Resistance of Structural Systems

U.S. NAVAL FACILITIES ENGINEERING SERVICE CENTER (NFESC)

NFESC CR 80.025	(1980) Testing and Evaluation of Attack Resistance and Hardening Retrofits of Marine Barrack Construction Types to Small Arms Multiple Impact Threat

UNDERWRITERS LABORATORIES (UL)

UL 752	(2005; Rev thru Dec 2006) Bullet-Resisting Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 Design Requirements

Bullet resistant components shall conform to the requirements specified for the particular items and as much as possible shall be complete assemblies by a single manufacturer.

1.2.2 Performance Requirements

All items specified shall be bullet resistant to the threat specified. Movable and operable components shall operate smoothly and freely. When a reference for performance is listed, operation shall conform to referenced requirements.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings containing complete wiring and schematic diagrams, where appropriate, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of components and appurtenances, and relationship to other parts of work including clearances for operation and maintenance. Drawings sufficient to show conformance to all requirements, including fabrication details, sizes, thickness of materials, anchorage, finishes, hardware location and installation.

SD-03 Product Data

Bullet Resistant Components

Manufacturer's descriptive data and installation instructions. Descriptive data shall include cleaning instructions as recommended by the plastic sheet manufacturer. Spare parts data for each bifold door, after approval of the related submittals, and not later than _____ months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and supply source. Air flow

calculations for louvers and louvers in doors shall be included.

Lists including schedule of all components to be incorporated in the work with manufacturer's model or catalog numbers, specification and drawing reference numbers, warranty information, threat level certified, fire ratings, sound transmission coefficient ratings, insulation "U" value, and number of items provided. Evidence that standard products essentially duplicate items that have been satisfactorily in use for two years or more, including name of purchasers, locations of installations, dates of installations, and service organizations.

Bifold Doors

A copy of the instructions proposed to be framed and posted.

SD-07 Certificates

Bullet Resistant Components

Manufacturer's certificates attesting that all components conform to the requirements on drawings and in specifications. Submittal shall include testing reports from independent testing laboratories indicating conformance to regulatory requirements.

SD-10 Operation and Maintenance Data

Bullet Resistant Components

Six copies of operation and six copies of maintenance manuals for the bifold doors furnished. The manuals shall be approved prior to beneficial occupancy.

1.4 STANDARD PRODUCTS

Materials and components shall be the standard products of a manufacturer regularly engaged in the manufacture of such products unless otherwise indicated and detailed on the drawings, and shall essentially duplicate items that have been in satisfactory use for at least two years prior to bid opening. Components shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site, or by the manufacturer. Where components are detailed on the drawings and do not conform to a manufacturer's standard product, components shall be constructed of manufacturer's standard materials which conform to the specified ballistic standard or test.

1.5 COMPONENT TEST REQUIREMENTS

Bullet-resistant components shall be provided at locations shown on the drawings. Bullet-resistant components where indicated shall be in accordance with NIJ Type I, NIJ Type IIA, NIJ Type II, NIJ Type IIIA of NIJ Std 0108.01. UL MPSA, UL HPSA, L SPSA, UL HPR of UL 752. ASTM Submachine Gun, ASTM Handgun (.44 Magnum), ASTM Handgun (.38 Super), ASTM Rifle (.44 Magnum), ASTM Rifle (AP) of ASTM F 1233. HPW Minimum Standard HPW Rifle Standard, HPW Rifle AP Standard of HPW TP-0501.01. SD Submachine Gun (S), SD Military Rifle (R), SD Rifle (AP) of SD Std-01.01, the test requirement of NFESC SAMIT, NFESC SAMIT (AP), of NFESC CR 80.025.

1.6 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the job site with the brand, name, and model number clearly marked thereon. All components shall be delivered, stored and handled so as not to be damaged or deformed, and in accordance with ASTM D 3951. Doors, windows, and louvers shall be handled carefully to prevent damage to the faces, edges, corners, ends, and glazing. Abraded, scarred, or rusty areas shall be cleaned, repaired, or replaced immediately upon detection. Damaged components that cannot be restored to like-new condition shall be replaced. Components and equipment shall be stored in a dry location on platforms or pallets that are ventilated adequately, free of dust, water, and other contaminants, and stored in a manner which permits easy access for inspection and handling.

1.7 WARRANTY

Manufacturer's warranty for 5 years shall be furnished for glazing materials. Warranty shall provide for replacement and installation of glazing if delamination, discoloration, or cracking, or crazing occurs.

PART 2 PRODUCTS

2.1 GENERAL

Bullet-resistant component assemblies shall be of size and type indicated and shall be provided at locations shown. All items included for exterior installation shall be designed to resist water penetration or entrapment.

2.2 ELECTRICAL WIRING

Electrical wiring and conduit shall be provided as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.3 FINISHES

All ferrous metal components except stainless steel shall be furnished primed for painting unless indicated otherwise. Finish painting shall be in accordance with Section 09 90 00 PAINTS AND COATINGS unless otherwise indicated. Aluminum items shall be finished in standard mill finish unless otherwise specified. When anodic coatings are specified, the coatings shall conform to AAMA 611, with coating thickness not less than that specified for protective and decorative type finish in AA DAF-45. Items to be anodized shall receive a polished satin finish pretreatment and a clear lacquer overcoat.

2.4 BULLET-RESISTANT STEEL PERSONNEL DOORS

Door/frame assemblies shall be factory fabricated units, designed to be bullet resistant to the specified threat level, and shall conform to applicable requirements of NAAMM HMMA 810, NAAMM HMMA 820, NAAMM HMMA 862, this section, and requirements indicated on drawings. Frames shall be furnished by the door fabricator. Door silencers shall be provided to cushion the impact of the door on the frame so that steel to steel contact is not made during closing. Exterior doors shall be completely weatherstripped, weatherproof, and fully insulated. Exterior doors shall close at flush top and bottom edges. Tops of doors shall be sealed against water penetration.

2.4.1 Fire Rated Doors

Fire rated doors shall be provided at locations shown on the drawings. Door assemblies shall bear the identifying label of the Underwriters Laboratories, or a nationally recognized testing agency qualified to perform certificate programs, indicating that the units conform to the requirements for Special Purpose Type Fire Doors in accordance with NFPA 80. Fire rated doors shall be constructed in accordance with NAAMM HMMA 850. Certificate may be furnished in lieu of label. For oversized fire doors, certificate shall state that doors are manufactured in compliance with the requirements for doors of this type and class, and have been tested and meet the requirements for the class indicated.

2.4.2 Sound Rated Doors

Sound rated doors shall be provided at locations shown on the drawings. Door assemblies shall consist of door, hardware, frame, threshold, and adjustable gaskets. The assembly shall have a Sound Transmission Class (STC) rating as shown on the drawings when tested in accordance with ASTM E 90. Manufacturer's descriptive data, and certificate or test report showing compliance with the specified requirements shall be submitted. The Contractor shall perform a field test on the door assembly to determine if the STC is within 2 points of the equivalent laboratory tested product. If the test reveals a less than acceptable STC, the Contractor shall replace the door assembly and test the new assembly to provide an acceptable rating.

2.4.3 Door and Frame Fabrication

Special care shall be exercised during welding to prevent warping. Design of stiffeners and attachment method of interior armor plates shall be such that heat-affected areas which result from welding do not allow a potential ballistic leak in product construction. The subsurfaces shall be flat, parallel, and plumb after fabrication. Doors and frames shall be constructed of bullet-resistant steel or hollow metal with internal armoring and the completed assembly shall meet the specified regulatory requirements. Doors shall be reinforced and fully insulated in accordance with manufacturer's design. Steel door frames shall be mitered or coped and welded at the corners with all welds ground smooth. Corner assemblies shall be designed to eliminate ballistic penetrable seams. Where structural channel frames are used, stops shall be made of 1-1/2 inch by 5/8 inch bars welded or top screwed to the frame at not more than 6, 12 inch centers. Screws shall be countersunk. Stops shall be so placed that full contact with the frame will be assured. Any necessary reinforcements shall be made and the frames shall be drilled and tapped as required for the hardware. Frame channels shall be mitered or coped and welded at corners with full penetration groove welds. Exposed welds shall be dressed smooth.

2.4.4 Sidelight Frames

Sidelight frames shall be constructed using door frame sections as shown on the drawings. Stop height and rabbet depth shall be as required to accommodate the bullet-resistant glazing material specified. Exterior (attack side) glazing stops shall be welded or integral to the frame. Interior (protected side) glazing stops shall be removable stops attached with high-strength alloy steel machine screws with tamper-resistant heads.

2.4.5 Preparation for Hardware

Doors and frames shall be prepared for hardware in conformance with Section

08 71 00 DOOR HARDWARE, and NAAMM HMMA 830. Drilling and tapping of frames for surface applied hardware shall be performed in the field.

2.4.6 Hardware

Hardware for bullet-resistant door assembly shall be provided by the door assembly manufacturer to ensure a complete bullet resistant assembly. Where test standard requires hardware to be tested with the door assembly, hardware shall be included in the labeling and/or test certification. Keying shall be as specified in Section 08 71 00 DOOR HARDWARE.

2.4.6.1 Mortise Locks and Latchsets

Mortise lock and latchsets shall be series 1000, operational Grade 1, Security Grade 1 or 1A, functions as indicated in the Hardware Schedule, and shall conform to BHMA A156.13. Strikes for all mortise locks and latches, including deadlocks, shall conform to BHMA A156.115 except strikes for security doors shall be rectangular, without lip. Mortise-type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts. Mortise locks and latches shall have full escutcheon, thru-bolted, extruded stainless steel trim.

2.4.6.2 Hinges

All 7 feet - 0 inch high doors shall be equipped with a minimum of three Grade 1 hinges in accordance with BHMA A156.1, minimum size 5 inches high, heavy, double or triple weight as required for weight of door, or a single, continuous extra-heavy-duty piano-type hinge sized to carry the weight of the door without sagging. For each additional 12 inches of door height beyond 7 feet - 0 inch, provide minimum of one more hinge shall be provided. Doors greater than 7 feet - 0 inches shall be equipped with a minimum of four hinges. Hinges shall be full mortise, half mortise, full surface or half surface design as recommended by manufacturer for frame and door design, and shall be tamperproof or mounted on the inside face of the door. The Contractor shall provide hinge manufacturer's certification that the hinge supplied meets all applicable test requirements of BHMA A156.1, type, number of hinges specified, and that the hinge is suitable for the size and weight of the door assembly on which it will be utilized. If continuous piano-type hinges are provided with door, independent laboratory reports covering both the door weight capacity and a 2,500,000-cycle testing to match BHMA A156.1 Grade 1 requirements shall be furnished by the Contractor. Interior door hinges shall be furnished in steel, prime coated. Exterior door hinges shall be nonferrous metal or stainless steel.

2.4.6.3 Electric Strikes

Electric strikes shall conform to BHMA A156.5, Grade 1. Strike boxes shall be furnished with dead bolt and latch strikes for Grade 1.

2.4.6.4 Door Closers

Closers shall be extra heavy duty of size and type recommended by manufacturer, and shall be Grade 1 in accordance with BHMA A156.4. Door closer finish shall be 600, 689, 690, 691, 692 in accordance with BHMA A156.18.

2.4.6.5 Door Stops and Holders

Door stops and holders shall be extra heavy duty, Type C08511 in accordance with BHMA A156.8, Type L11251 and Type L11271 in accordance with BHMA A156.16.

2.4.7 Frame Anchors

Jamb anchors shall be provided with door/frame assembly and shall conform to manufacturer's recommendations to ensure complete bullet-resistant assemblies. Provisions shall be made to stiffen the top member of all spans over 3 feet. The bottom of the frames shall extend below the finish floorline and shall be secured to the floor slab by means of angle clips and expansion bolts. Floor clips are not required for installation in pre-built or existing openings.

2.4.8 Weatherstripping

Head and jambs shall be provided with compression-type neoprene bulb or closed-cell neoprene adjustable-type weatherstripping. Door stops shall be weatherstripped with a surface-mounted sponge neoprene strip in bronze housing not less than 0.070 inch thick installed to make contact with the door. Weatherstripping shall be installed in conformance with the manufacturer's directions after completion of finish painting.

2.4.9 Louvers for Doors

Where indicated, doors shall be provided with full louvers or louver section. Louvers shall be certified resistant to the same ballistic threat level as the rest of the door assembly. Louvers shall be sightproof type inserted into the door. Pierced louvers shall not be used. Inserted louvers shall be stationary and shall be nonremovable from the outside of exterior doors or the threat side of interior doors. Insect screens shall be removable type with 18 by 16 mesh aluminum or bronze cloth. Where required by test standard, louvers shall be provided with a spall-resistant screen of fine stainless steel mesh. The free area of the total square feet of the louver shall be 17 percent for channel style louvers, 39 percent for chevron style louvers (inverted angles at 1 inch on center) percent. Louver submitted shall have been tested in accordance with AMCA 500-D airflow test, minimum airflow shall be _____ percent for channel style, ____ percent for chevron style. Airflow calculations and test data showing compliance shall be submitted.

2.5 BULLET-RESISTANT LOUVERS

Louvers and frames shall be fabricated from steel shapes to the opening dimensions indicated. The louvers shall be factory fabricated units designed to be bullet-resistant to the specified test standard in paragraph COMPONENT TEST REQUIREMENTS. Manufacturer's descriptive data, certificate, and test report showing compliance with the specified forced entry standard shall be submitted. The free area of the total square feet of the louver shall be 17 percent for channel style louvers, 39 percent for chevron style louvers (inverted angles at 1 inch on center). Louver submitted shall have been tested in accordance with AMCA 500-D airflow test. Minimum airflow shall be _____ percent for channel style, _____ percent for chevron style. Airflow calculations and test data showing compliance shall be submitted.

2.6 BULLET-RESISTANT STEEL BIFOLD DOORS, FRAMES, AND HARDWARE

2.6.1 Testing

Bullet-resistant bifold door shall be subjected to testing by manufacturer to demonstrate appropriate design, strength, and application and operation of all hardware, both manual and electric. Door tests shall replicate actual installation to the maximum extent possible. Provide test results to the Contracting Officer.

2.6.2 Power Operators

Power operators shall be pneumatic, electric type conforming to NFPA 80 and the requirements specified herein. Readily adjustable limit switches shall be provided to automatically stop the door in its full open or closed position. All operating devices shall be suitable for the hazardous Class, Division, and Group shown, as defined in NFPA 70.

2.6.2.1 Electric Operators

Electric operators shall be heavy-duty industrial type designed to operate the door at not less than 8 inches nor more than 1 foot/second. Electrical controls shall be push button wall switches, ceiling pull switches, rollover floor treadle as indicated. Electric power operators shall be complete with electric motor, brackets, controls, limit switches, magnetic reversing starter, and all other accessories necessary. The operator shall be designed so that the motor may be removed without disturbing the limit-switch timing and without affecting the emergency operator. The power operator shall be provided with a slipping clutch coupling to prevent stalling of the motor. Operators shall have provisions for immediate emergency manual operation of the door in case of electrical failure. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the starter. Control voltage shall be 120 volts or less.

a. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient horsepower and torque output to move the door in either direction from any position at the required speed without exceeding the rated capacity. Motors shall be suitable for operation on _____ volts, 60 hertz, single, three phase, and shall be suitable for across-the-line starting. All motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating.

b. Controls: Each door motor shall have an enclosed reversing across-the-line type magnetic starter having thermal overload protection, limit switches, and remote control switches. The control equipment shall conform to NEMA ICS 2; enclosures shall be NEMA ICS 6, Type 12 (industrial use), Type 7 or 9 in hazardous locations, or as otherwise indicated. Each wall control station shall be of the three-button type, with the controls marked and color coded: OPEN - white; CLOSE - green; and STOP - red. When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation.

2.6.3 Safety Device

The leading edge of doors shall have a safety device that will immediately reverse the door movement upon contact with an obstruction and cause the door to return to its full open position. The safety device shall not substitute for a limit switch. Exterior doors shall be provided with a combination weather seal and safety device on the leading edge.

2.7 BULLET-RESISTANT STEEL WINDOWS

Window assemblies shall be fabricated from bullet-resistant steel shapes or hollow metal with internal armoring and bullet-resistant glazing materials specified herein; the entire assembly shall meet or exceed the specified regulatory requirements. Frames shall be welded units of sizes and shapes indicated on the drawings with minimum frame face dimensions of 2 inches. Glazing material shall be furnished with window assembly for on-site installation, or windows shall be factory glazed units. Entire assembly shall be furnished by same manufacturer. Exterior (attack side) glazing stops shall be welded or integral to frame. Interior (protected side) glazing stops shall be removable stops attached with high-strength alloy steel machine screws with tamper-resistant heads.

2.7.1 Glazing Materials

Glazing material shall be factory fabricated units designed to be bullet-resistant to the specified test standard in paragraph COMPONENT TEST REQUIREMENTS. Glazing material shall be glass, plastic, or composite with a no-spall, low-spall protected (interior) face. Low-spall interior face shall meet or exceed requirements for spall resistance defined in UL 752. No-spall interior face shall meet requirements for spall resistance defined in HPW TP-0501.01. Glazing material shall conform to applicable requirements contained in ASTM C 1036, ASTM C 1048, and ASTM E 1300. Glazing materials shall be tested in accordance with the applicable sections of the following testing procedures: ASTM D 905, ASTM D 1003, ASTM F 428, ASTM F 548, ASTM D 4093, and ASTM F 520. All plastic glazing exposed to the interior or exterior environment shall have an applied hardcoat.

2.7.1.1 Laminated Glass

Bullet-resistant laminated glass shall be all glass laminated construction conforming to applicable sections of ASTM C 1172. The adhesive interlayer material for bonding glass to glass shall be chemically compatible with the surfaces which are to be bonded. Materials selected for lamination purposes shall be tested in accordance with the following testing procedures: ASTM D 905, ASTM D 1044, ASTM F 735, ASTM D 4093, ASTM F 521, ASTM F 520, and ASTM D 1003. Glass plies used in the lamination shall be annealed float glass conforming to Type I, quality q3 Class 1, in accordance with ASTM C 1036 or heat-strengthened or fully heat tempered, float glass, Condition A, Type I, q3 Class 1, in accordance with ASTM C 1048.

2.7.1.2 Glass/Plastic Laminate Glazing

Bullet-resistant glass/plastic laminated glazing materials shall be glass/plastic laminated construction or glass-clad plastic "sandwich" construction conforming to applicable sections of ASTM C 1172. Polycarbonate shall be ultraviolet stabilized.

2.7.1.3 Glass/Plastic Air-Gap Glazing

Bullet-resistant glass/plastic air-gap glazing shall consist of an assembly in which glass forms the exterior and interior (protected side) layer, separated by an air space from the laminated plastic plies. Exterior glass plies shall be annealed float glass conforming to Type I, quality q3 Class 1, in accordance with ASTM C 1036 or heat-strengthened or fully heat tempered, float glass, Condition A, Type I, q3 Class 1, in accordance with ASTM C 1036 or heat-strengthened or fully heat tempered, float glass, Condition A, Type I, q3 class 1, in accordance with ASTM C 1048. Interior (protected side) glass plies shall be annealed float glass conforming to Type I, quality q3 Class 1, in accordance with ASTM C 1036 or heat-strengthened or fully heat tempered, float glass, Condition A, Type I, q3 Class 1, in accordance with ASTM C 1048. Where annealed glass is used on the protected side of the window, a sheet of 4 mil thick clear mylar fragment retention film shall be applied to the interior surface in accordance with film manufacturer's instructions. Film that wraps around the edges of the glass shall be applied prior to glazing the window. Plastic plies shall consist of laminated ultraviolet stabilized polycarbonate sheets, conforming to paragraph Polycarbonate Plastic Sheets and/or acrylic sheets for use "as cast" and in stretching operations with improved moisture absorption resistance conforming to applicable requirements of paragraph Polycarbonate Plastic Sheets.

2.7.2 Sealants

Sealants for glazings shall be chemically compatible with the glazing materials they contact with no deleterious effects to the glazing materials or to the adhesives used in laminates. Sealants shall be in accordance with glazing manufacturer's recommendations and GANA Glazing Manual.

2.7.3 Deal Trays

Deal tray shall provide nominal 12-3/4 inch wide by 1-5/8 inch high opening in sill of window frame and shall include a 6-1/2 inch steel writing ledge on exterior side of window. Deal tray shall be welded subassembly of window assembly and shall conform to specified requirements for entire window assembly. Opening configuration of deal tray shall prevent ballistic penetration or spall from the threat weapon, and shall resist lead spray from a shotgun blast. Tray opening shall prevent insertion of the muzzle of a firearm.

2.8 BULLET-RESISTANT SPEAKING APERTURES

Speaking apertures shall allow passage of voice at normal speaking volume without distortion, shall be fabricated to resist the specified threat level for outdoor, indoor use, and shall be designed to prevent direct aim by the insertion of the muzzle of any firearm. Finish shall match window, door construction in which aperture is installed.

2.9 BULLET-RESISTANT GUNPORTS

Gunport shall operate only from the protected side of the barrier, with a protected side shutter that closes automatically and is lockable from the protected side. Gunport shall be fabricated from bullet resistant steel shapes and the entire assembly shall meet or exceed the specified regulatory requirements. Gunport shall be sized for operation using submachine guns and rifles. Assembly shall provide a weather resistant opening. Shutter shall be hinged or pivoted and shall not obstruct

operation when in open position. Attachment to wall assembly shall be in accordance with manufacturer's recommendations. All aspects of gunport assembly, including hardware and method of anchorage to wall, shall be included in labeling or test certification. Finish shall be primed for painting, satin stainless steel. Gunport shall not be operable from exposed side.

2.10 BULLET-RESISTANT PASS-THROUGH DRAWER

Pass-through drawer shall be fabricated from bullet-resistant steel shapes and the entire assembly shall meet or exceed the specified regulatory requirements. Pass-through drawer shall be of size indicated on the drawings and shall be designed to prohibit forcible entry or direct aim by the insertion of the muzzle of a firearm from exterior side when drawer is in the open position. Assembly shall provide a weather resistant opening. Attachment to wall assembly shall be in accordance with manufacturer's recommendations. All aspects of the assembly, including hardware and method of anchorage to wall, shall be included in the labeling or test certification. Finish shall be primed for painting, satin stainless steel.

2.11 ACCESSORIES

All accessories shall be provided for the installation or erection of above components into the surrounding structure. Anchorage shall be as strong and bullet-resistant as the components. Installation/erection shall be per manufacturer's recommended instructions.

2.12 LABELING

Bullet-resistant equipment shall be plainly and permanently labeled in accordance with regulatory requirements. Label shall be compatible with plastic or coating. Label shall be visible only on protected side, after installation and shall include the following information:

a. Manufacturer's name or identifying symbol

b. Model Number, Control Number, or equivalent

c. Date of manufacture by week, month or quarter and year. This may be abbreviated or be in a traceable code such as the lot number.

d. Correct mounting position including threat side and secure side (by removable label on glazing material).

e. Code indicating bullet-resistant rating and test standard used (by removable label on glazing material).

2.13 FASTENERS

Fasteners exposed to view shall match in color and finish and shall harmonize with the material to which fasteners are applied. Fasteners shall be in accordance with Section 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS.

2.14 CORROSION PROTECTION - DISSIMILAR MATERIALS

Contact surfaces between dissimilar metals and aluminum surfaces in contact with concrete, masonry, pressure-treated wood or absorptive materials subject to wetting, shall be given a protective coating in accordance with

Section 09 90 00 PAINTS AND COATINGS.

2.15 SHOP/FACTORY FINISHING

All factory or manufactured components shall be shop finished as indicated below.

2.15.1 Ferrous Metal

Surfaces of ferrous metal, except galvanized and stainless steel surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating other than a bituminous protective coating, compatible with finish coats. Prior to shop painting, surfaces shall be cleaned with solvents to remove grease and oil, and with power wire-brushing or sandblasting to remove loose rust, loose mill scale and other foreign substances. Surfaces of items to be embedded in concrete shall not be shop painted.

2.15.2 Galvanizing

Items specified to be galvanized shall be hot-dip processed after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M or ASTM A 653/A 653M as applicable.

2.15.3 Aluminum

Unless otherwise specified, aluminum items shall be standard mill finish. Anodic coatings shall conform to paragraph FINISHES.

PART 3 EXECUTION

3.1 EXAMINATION

Existing work shall be examined to ensure that it is ready for installation or erection of the components. Components shall be checked and corrected for racking, twisting, and other malformation prior to installation. Frames must be set true and plumb and remain aligned for proper installation. All surfaces and connections shall be examined for damage prior to installation.

3.2 PREPARATION AND PROTECTION

The Contractor shall field verify dimensions of rough openings for components, and shall verify that surfaces of openings are plumb, true, and provide required clearances. The Contractor shall protect surrounding work prior to installation of bullet-resistant components. Surrounding work which is damaged as a result of the installation of bullet-resistant components shall be restored to like-new condition prior to acceptance of the work described herein.

3.3 INSTALLATION

The finished work shall be rigid, neat in appearance and free from defects. Equipment shall be installed plumb and level, and secured rigidly in place. Installation of doors and frames shall conform to NAAMM HMMA 840. Doors, frames, and hardware shall be installed in strict compliance with approved printed instructions and detail drawings provided by the manufacturer. The Contractor shall be responsible for proper installing of the door assembly so that operating clearances and bearing surfaces conform

to manufacturer's instructions. Weatherstripping and thresholds shall be installed at exterior door openings to provide a weathertight installation. All other components shall be installed in accordance with approved manufacturer's recommended instructions. All operable parts of components shall be tested for smooth, trouble-free operation, in the presence of the Contracting Officer's representative.

3.4 ELECTRICAL WORK

All electrical work shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Flexible connections between doors and fixed supports shall be made with extra flexible type SO cable, except in hazardous locations where wiring shall conform to NFPA 70. The cable shall have a spring-loaded automatic take up reel, or an equivalent and approved device.

3.5 ADJUSTING/CLEANING

Adjustments shall be made to doors and pass-thru drawers to assure smooth operation. Units shall be weathertight when closed and locked. All components shall be cleaned in accordance with manufacturer's instructions.

3.6 SCHEDULING

Glazing of bullet-resistant windows except factory-glazed units shall occur only after all concrete, masonry, ceiling, electrical, mechanical, plumbing and adjacent finish work has been completed to avoid damage to the glazing material. Factory-glazed windows shall be covered to protect them from damage during adjacent finish work.

-- End of Section --

SECTION 08 34 53.00 40

SECURITY DOORS AND FRAMES

06/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

UNDERWRITERS LABORATORIES (UL)

UL 140	(2006) Standard for Relocking Devices for Safes and Vaults
UL 155	(2005) Standard Tests for Fire Resistance of Vault and File Room Doors
UL 768	(2006; Rev thru Mar 2007) Standard for Combination Locks

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation drawings shall be submitted which include details of construction, method of anchorage and type and location of the following:

Vault-Door Units
Hardware
Frames and Sills
Day Gate

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Doors
Frames and Sills
Day Gate

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Doors

Hardware
Frames and Sills
Day Gate

1.3 DELIVERY, HANDLING, AND STORAGE

Doors and frames shall be delivered, stored, and handled in a manner that will prevent damage.

PART 2 PRODUCTS

2.1 GENERAL

Vault-Door Units shall be insulated, steel, flat sill, record vault doors with frames and shall be the standard product of a manufacturer specializing in this type of construction.

2.2 DOORS

Design and construction of doors shall be the manufacturer's standard, shall have the fire resistant classification conforming to UL 155, and shall bear the UL label on the door and frame for the exposure rating required.

Exposure rating shall be 6, 4, 2 hours.

Doors shall be of the size indicated.

Hardware shall mee the following specifications:

There shall be five bolts for each side of the door, 11/16-inch diameter minimum, permanently lubricated. Exposed bolt work shall be corrosion resistant or nickel plated steel.

Relocking devices shall conform to UL 140.

Escape mechanisms shall be panic bar type or other approved type requiring no tools or special instructions for operation.

Hinges shall be the offset type with roller or ball bearings, three per door, unless otherwise noted on the drawings.

Locks shall be combination three- or four-tumbler key changing type with metal cases protected by case hardened drill resistive steel plates and operated by lever handles.

Lock shall be highly resistant to expert manipulation and conform to UL 768, Group I, combination locks.

Lock shall be reasonably resistant to unauthorized opening and conform to Group II of UL 768 combination locks.

2.3 FRAMES AND SILLS

Frame shall be the tongue-and-groove interlocking type constructed of cold formed steel, formed from a single length for each jamb, and a single length for the head. Heads and jambs shall be continuously welded along the entire intersection. Sills shall be flat and not less in width than the jambs. Frame jambs and heads shall be insulated with the same material

as the door. Frame shall be designed for the indicated thickness of the vault wall.

2.4 FINISH

Finish for doors, frames, and hardware shall be the manufacturer's standard type.

2.5 DAY GATE

Vault door unit shall include a day gate of the manufacturer's standard make; the door frame shall be designed to accommodate the day gate. Gate shall be the swing-in hinged type, with not less than diameter rods, and the gate frame shall be not less than 3/8- by 1-1/4-inch steel members. Gate shall be equipped with locking devices arranged to permit locking and unlocking the gate from the inside only. Finish shall be the manufacturer's standard finish. Gate shall not interfere with the operation of escape devices.

PART 3 EXECUTION

3.1 INSTALLATION

Vault door unit shall be installed in strict compliance with the approved printed instructions and drawings provided by the manufacturer.

3.2 ADJUSTMENT

After installation, the inner escape device shall be adjusted for proper operation.

-- End of Section --

SECTION 08 34 59

SECURITY VAULT DOOR

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-D-600 (Rev C, Am 1) Door, Vault, Security

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Vault door Unit
Day gate

Show head, jamb, and sill sections, and elevations of the doors and gate.

SD-03 Product Data

Vault Door and Frame

Manufacturer's catalog data including catalog cuts and brochures. The data shall show that the proposed vault door unit conforms with the requirements in FS AA-D-600, and has been tested and approved by the General Services Administration (GSA).

SD-07 Certificates

Vault Door and Frame

Certification shall state that vault-door units that do not bear the GSA label are constructed to Class 5 standards.

SD-08 Manufacturer's Instructions

Installation

Printed instructions and drawings provided by the manufacturer.

1.3 GENERAL REQUIREMENTS

The vault door unit shall be a steel security-vault type door with frame, day gate, and ramp type threshold, and shall be a standard product of a

manufacturer specializing in this type of fabrication.

1.4 DELIVERY AND STORAGE

Door and frame assemblies shall be delivered to the jobsite in a protective covering with the brand and name clearly marked thereon. Materials delivered to the jobsite shall be inspected for damage, and unloaded with a minimum of handling. Storage shall be in a dry location with adequate ventilation, free from dust, water, and other contaminants, and which permits easy access for inspection and handling. Door assemblies shall be stored off the floor on nonabsorptive strips or wood platforms. Damage to doors and frames shall be prevented during handling. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 VAULT DOOR AND FRAME

Design and construction of the door and frame assembly shall conform to FS AA-D-600. The door shall be Class 5, Type IR - right opening swing with optical device, IL - left opening swing with optical device, IIR - right opening swing without optical device, IIL - left opening swing without optical device, III R - double leaf, right opening swing active leaf, III L - double leaf, left opening swing active leaf, Style H - hand change combination lock, K - key change combination lock, Design S - single lock, B - no exterior hardware. The optical device shall permit observation from the inside to the outside, outside to the inside of the vault.

2.2 DAY GATE

The day gate shall be the manufacturer's standard, custom product designed for use with the vault door furnished, and shall provide access control and visual security and material, equipment, weapons issue. The gate shall be hinged on the same side as the vault door, shall swing into the vault, and shall have a locking device operable from outside by key and from inside by knob or handle. Gate shall include an issue port hatch and 12 gage thick steel shelf. The issue port shall be a framed 8 by 12 inch opening with a minimum 22 gage thick steel protective door (hatch cover) which is hinged and lockable from the interior side. The issue port frame shall be welded to the day gate. The shelf shall be 12 inches deep by width to match the port hatch. Provide the manufacturer's standard finish. The day gate shall not interfere with the operation of vault door inner escape device.

PART 3 EXECUTION

3.1 INSTALLATION

The vault door assembly shall be installed in strict compliance with the printed instructions and drawings provided by the manufacturer. The day gate shall be installed in a manner that will not interfere with operation of the release handle on the inside of the vault door. After installation, the door, the locking mechanism, and the inner escape device shall be adjusted for proper operation.

-- End of Section --

SECTION 08 36 13

SECTIONAL OVERHEAD DOORS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 227/A 227M	(2006) Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs
ASTM A 229/A 229M	(1999; R 2005) Standard Specification for Steel Wire, Oil-Tempered for Mechanical Springs
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C 1363	(2005) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)

DASMA 102	(2003) Sectional Overhead Type Doors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2000; R 2005) Standard for Industrial Control and Systems General Requirements
NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 6	(1993; R 2006) Standard for Industrial Controls and Systems Enclosures
NEMA MG 1	(2007) Standard for Motors and Generators
NEMA ST 20	(1992; R 1997) Standard for Dry-Type Transformers for General Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Doors

Show types, sizes, locations, metal gages including minimum metal decimal thickness, hardware provisions, installation details, and other details of construction. For electrically-operated doors, include supporting brackets for motors, location, type, and ratings of motors, switches, and safety devices.

SD-03 Product Data

Doors

Electric operators

For electrically motor-operated doors, submit manufacturer's wiring diagrams for motor and controls.

SD-08 Manufacturer's Instructions

Doors

SD-10 Operation and Maintenance Data

Doors

Submit Data Package 2 in accordance with Section 01 78 23

OPERATION AND MAINTENANCE DATA.

1.3 DELIVERY, STORAGE, AND HANDLING

Protect doors and accessories from damage during delivery, storage, and handling. Clearly mark manufacturer's brand name. Store doors in dry locations with adequate ventilation, free from dust and water. Remove damaged items and provide new. Provide easy access for inspection and handling of overhead doors prior to installation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Hard-Drawn Springwire

ASTM A 227/A 227M.

2.1.2 Oil-Tempered Springwire

ASTM A 229/A 229M.

2.1.3 Steel Sheet

ASTM A 653/A 653M.

2.1.4 Steel Shapes

ASTM A 36/A 36M.

2.1.5 Aluminum Extrusions

ASTM B 221, Alloy 6063-T5.

2.1.6 Aluminum Sheets and Strips

ASTM B 209, alloy and temper best suited for the purpose.

2.1.7 Glass

Fully tempered, clear float glass 1/8 inch thick.

2.2 DOORS

DASMA 102. Residential, Commercial, Industrial doors. Metal doors to have horizontal sections hinged together which operate in a system of tracks to completely close the door opening in the closed position and make the full width and height of the door opening available for use in the open position. Provide a permanent label on the door indicating the name and address of the manufacturer. Provide doors with standard lift type designed to slide up and back into a horizontal overhead position and requiring a maximum of 16 inch of headroom for 2 inch tracks and 21 inch of headroom for 3 inch tracks, low headroom type designed to slide up and back into a horizontal overhead position and requiring a maximum of 10 inch of headroom for 2 inch tracks and 12 inch of headroom for 3 inch tracks, high lift type designed to slide up and back into a combination vertical and horizontal position, vertical lift type designed to slide upward into a vertical position. Doors operate by lifting handles, by hand chain with gear or sprocket reduction, by hand crank with gear or sprocket reduction,

by electric power with auxiliary hand chain operation.

2.3 DESIGN REQUIREMENTS

Conform to DASMA 102 and conform to the design mind load for the building except that design wind load _____ pounds per square foot. Provide doors to remain operable and undamaged after conclusion of tests conducted in accordance with ASTM E 330 using the design wind load.

2.4 FABRICATION

2.4.1 Steel Overhead Doors

Form door sections of hot-dipped galvanized steel not lighter than 16 gage with flush surface without ribs or grooves or 20 gage with longitudinal integral reinforcing ribs or 24 gage with longitudinal integral reinforcing ribs and flat bottom V-grooves. Install sections not less than 2 inch in thickness. Meeting rails to have interlocking joints to ensure a weathertight closure and alignment for full width of the door. Provide sections of the height indicated or the manufacturer's standard. Do not exceed thick 24 inch height for intermediate sections. Bottom sections may be varied to suit door height. Do not exceed 30 inch height for bottom section. Provide glass panels and install panels using manufacturer's standard for rubber gaskets.

2.4.1.1 Insulated Sections

Insulate door sections with fibrous glass or plastic foam to provide a "U" factor of 0.14 or less when tested in accordance with ASTM C 1363. Cover interior of door sections with steel sheets of not lighter than24 gage to completely enclose the insulating material.

2.4.2 Tracks

Provide galvanized steel tracks not lighter than 14 gage for 2 inch tracks and not lighter than 12 gage for 3 inch tracks. Provide vertical tracks with continuous steel angle not lighter than 13 gage for installation to walls. Incline vertical track through use of adjustable brackets to obtain a weathertight closure at jambs. Reinforce horizontal track with galvanized steel angle; support from track ceiling construction with galvanized steel angle and cross bracing to provide a rigid installation.

2.4.3 Hardware

Provide hinges, brackets, rollers, locking devices, and other hardware required for complete installation. Install roller brackets and hinges with14 gage galvanized steel. Provide rollers with ball bearings and case-hardened races. Provide reinforcing on doors where roller hinges are connected. Provide a positive locking device and cylinder lock with two keys on manually operated doors.

2.4.4 Counterbalancing

Counterbalance doors with an oil-tempered, helical-wound torsional spring mounted on a steel shaft. Provide adjustable spring tension, connect spring to doors with cable through cable drums. Provide cable safety factor of at least 7 to 1.

2.5 MANUAL OPERATORS

2.5.1 Pushup Operators

Provide lifting handles on both sides of door. Do not exceed the maximum lifting force of 25 pounds required to operate the door. Provide pulldown straps or ropes at bottom of doors over 7 feet high.

2.5.2 Chain Hoist Operators

Provide a galvanized, endless chain operating over a sprocket. Extend chain to within 4 feet of the floor and mount on inside of building. Obtain reduction by use of roller chain and sprocket drive or gearing. Provide chain cleat and pin for securing operator chain. Allow for future installation of power operators to chain hoist operator. Do not exceed the maximum lifting force of 35 pounds required to operate the door.

2.6 ELECTRIC OPERATORS

2.6.1 Operator Features

Provide operators of the drawbar type or side mount (jack shaft) type as recommended by the manufacturer. Include operators with electric motor, machine-cut reduction gears, steel chain and sprockets, magnetic brake, brackets, pushbutton controls, limit switches, magnetic reversing contactor, a manual chain hoist operator for emergency use, and other accessories necessary for operation. Design electric operator so motor may be removed without disturbing the limit switch timing and without affecting the manual operator. Provide the operator with slipping clutch coupling to prevent stalling the motor. Provide a clutch controlled emergency manual operator so that it may be engaged and disengaged from the floor; do not affect limit switch timing by operation. The manual operator is not required if door can be manual-pushup operated with a force not to exceed 25 pounds. Provide an electrical or mechanical device that disconnects the motor from the operating mechanism when the manual operator is engaged.

2.6.2 Motors

NEMA MG 1, high-starting torque, reversible type with sufficient horsepower and torque output to move the door in either direction from any position. Provide a motor to produce a door travel speed of not less than 8 inch or more than one foot per second without exceeding the rated capacity. Motors shall be operate on current of the characteristics indicated at not more than 3600 rpm. Single-phase motors shall not have commutation or more than one starting contact. Provide motor enclosures with drip-proof type or NEMA TENV type.

2.6.3 Controls

Provide a motor for each door with an enclosed, across-the-line type, magnetic reversing contactor, thermal overload and undervoltage protection, solenoid-operated brake, limit switches, and control switches. Locate control switches at least 5 feet above the floor so the operator will have complete visibility of the door at all times. Provide control equipment to conform to NEMA ICS 1 and NEMA ICS 2. Provide control enclosures with NEMA ICS 6, Type 12 or Type 4, except that contactor enclosures may be Type 1. Provide a three-button type control switch stations with buttons marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" buttons shall require only momentary pressure to operate. The "CLOSE" button shall require

constant pressure to maintain the closing motion of the door. If the door is in motion and the "STOP" button is pressed or the "CLOSE" button released, the door shall stop instantly and remain in the stop position; from the stop position, the door may be operated in either direction by the "OPEN" or "CLOSE" button. Pushbuttons shall be full-guarded to prevent accidental operation. Provide limit switches to automatically stop doors at the fully open and closed positions. Limit switch positions shall be readily adjustable.

2.6.4 Safety Device

Provide an electric type safety device on the bottom edge of electrically-operated doors. The device shall immediately stop and reverse the door movement during the closing travel upon contact with an obstruction in the door opening or upon failure of any component of the control system. Provide for an automatic lock-out on the door closing circuit and a manually operable door until the failure or damage has been corrected.

2.6.5 Control Transformers

NEMA ST 20. Provide transformers in power circuits as necessary to reduce the voltage on the control circuits to 120 volts or less.

2.6.6 Electrical Components

NFPA 70. Furnish manual or automatic control and safety devices, including extra flexible Type SO cable and spring-loaded automatic takeup reel or equivalent device, for operation of the doors. Conduit wiring and mounting of controls are specified in the corresponding electrical specification section.

2.6.7 Hazardous Locations

Conform to NFPA 70 In addition to meeting other requirements specified, electrical materials, equipment, and devices for installation in hazardous locations and be specifically approved by Underwriters Laboratories or by an independent testing agency using equivalent standards, for the particular chemical group and the class and division of hazardous location involved.

2.7 WEATHER SEALS AND SAFETY DEVICE

Provide exterior doors with weatherproof joints between sections by means of tongue-and-groove joints, rabbetted joints, shiplap joints, or wool pile, vinyl or rubber weatherstripping; a rubber, wool pile, or vinyl, adjustable weatherstrip at the top and jambs; and a compressible neoprene, rubber, wool pile, or vinyl weather seal attached to the bottom of the door. On exterior doors that are electrically operated, the bottom seal shall be combination compressible weather seal and safety device for stopping and reversing door movement. Interior doors that are electrically operated shall have a compressible type of safety device for stopping and reversing door movement.

2.8 FINISHES

Hot-dip galvanize concealed metal surfaces and tracks in accordance with ASTM A 123/A 123M. Hot-dip galvanized and other ferrous metal surfaces, except rollers and lock components, which are shop primed.

2.8.1 Galvanized and Shop Primed

Provide a zinc coating on specified surfaces, a phosphate treatment, and a shop prime coat of rust-inhibitive paint. Conform to ASTM A 653/A 653M for galvanized coating, coating designation G60, for steel sheets, and ASTM A 123/A 123M for assembled steel products. The weight of coatings for assembled products shall be as designated in Table I of ASTM A 123/A 123M for the class of material to be coated. Provide a prime coat especially developed for materials treated by phosphates and adapted to application by dipping or spraying. Repair damaged zinc-coated surfaces with galvanizing repair paint and spot prime. At the Contractor's option, a two-part system including bonderizing, baked-on epoxy primer, and baked-on enamel topcoat may be applied in lieu of prime coat specified.

PART 3 EXECUTION

3.1 INSTALLATION

NFPA 70. Install doors in accordance with approved shop drawings and manufacturer's written installation instructions. Lubricate and adjust doors to operate freely.

Provide a weathertight installation and free from warp, twist, or distortion. Adjust and lubricate doors to operate freely.

Provide all items and accessories for a complete installation in every respect.

3.2 ELECTRICAL WORK

NFPA 70. Conduit, wiring, and mounting of controls.

3.3 TESTING

After installation is complete, operate doors to demonstrate installation and function of operators, safety features, and controls. Correct deficiencies.

-- End of Section --

SECTION 08 39 54

BLAST RESISTANT DOORS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2007) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A5.4/A5.4M	(2006) Stainless Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2008) Structural Welding Code - Sheet Steel
AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 242/A 242M	(2004e1) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2007a) Standard Specification for

	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 354	(2007a) Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 449	(2007b) Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A 490	(2006) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 500/A 500M	(2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(2005) Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(2005) Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 534	(2004) Standard Specification for Carburizing Steels for Anti-Friction Bearings
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 572/A 572M	(2007) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 574	(2004e1) Standard Specification for Alloy Steel Socket-Head Cap Screws
ASTM A 588/A 588M	(2005) Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A 606	(2004) Standard Specification for Steel Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved

	Atmospheric Corrosion Resistance
ASTM A 618/A 618M	(2004) Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 792/A 792M	(2006a) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 90	(2004) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM F 436	(2007a) Hardened Steel Washers
ASTM F 568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
ASTM F 835	(2004e1) Alloy Steel Socket Button and Flat Countersunk Head Cap Screws

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.13	(2005) Mortise Locks & Latches, Series 1000
BHMA A156.3	(2001) Exit Devices
BHMA A156.4	(2000) Door Controls - Closers
BHMA A156.8	(2005) Door Controls - Overhead Stops and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2005; Errata 2006; TIA 2006; TIA 2006) Life Safety Code, 2006 Edition
NFPA 252	(2007) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

NFPA 80A (2007) Recommended Practice for Protection of Buildings from Exterior Fire Exposures

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

For special doors or standard doors with appreciable modifications, detailed fabrication and assembly drawings indicating the door location and showing dimensions, materials, fabrication methods, hardware, and accessories in sufficient detail to enable the Contracting Officer to check compliance with contract documents. Weld symbols used shall conform to AWS A2.4. These drawings need not be submitted for standard doors for which manufacturer's catalog data is submitted.

SD-03 Product Data

Door Description

Data on standard blast doors consisting of catalog cuts, brochures, circulars, specifications, and product data that show complete dimensions and completely describe overpressure ratings, rebound ratings, doors, frames, anchors, hardware, and accessories.

Design Requirements

Detailed structural analysis and design calculations demonstrating resistance to blast when blast resistance is not demonstrated by prototype tests. Design calculations shall demonstrate adequacy under the blast effects specified or indicated. Design calculations shall include a sketch of the overpressure waveform; dimensioned sketches of blast resisting elements such as door members, frame members, latches, and hinges; section properties for blast resisting members including built-up sections; the standard under which steel is produced; static and dynamic material strength properties; the resistance, stiffness, mass, elastic natural period, and elastic deflection for flexural members; and the peak deflection, peak support rotation, and time to peak deflection for door members in flexure. Design calculations shall cover initial response, rebound, and all secondary items such as shear, welds, local buckling, web crippling, hinges, and latches.

Door Description

Manufacturer's instructions for installation and field testing.

Manufacturer's Field Service

Information describing training to be provided, training aids to be used, and background data on the personnel conducting the training.

SD-06 Test Reports

Tests
Tests, Inspections, and Verifications

Shop and field operating test reports that include values for opening and closing forces and times, forces required to operate latches, and a description of all operating tests performed.

Fire Rating Test and Inspection

In lieu of a UL listing for fire door assemblies, a letter may be submitted by the testing laboratory which identifies the submitted product by manufacturer and type or model and certifies that it has tested a sample assembly and issued a current listing.

Prototype Static Test
Prototype Blast Test

Certified test reports demonstrating blast resistance. Test reports shall include the name and location of the testing agency or laboratory, a description of the testing apparatus, the date of the tests, a description of the door specimen tested, descriptions of loadings, and the value of measured peak door deflection and peak permanent set. Test reports shall include analysis and interpretation of test results.

SD-07 Certificates

Materials

Steel mill reports covering the number, chemical composition, and tension properties for structural quality steels. When blast resistance is demonstrated by calculations, a certificate stating that the door assembly provided was manufactured using the same materials, dimensions, and tolerances shown in the calculations. When blast resistance is demonstrated by prototype testing, a certificate stating that door and frame provided was manufactured using the same materials, dimensions, and tolerances as the tested prototype and listing the hardware and frame anchors required to achieve blast resistance. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturer and shall identify the door assembly and date of shipment or delivery to which the certificate applies.

Fire-Rated Door Assemblies

Certificate of inspection conforming to NFPA 80, NFPA 80A, and NFPA 101 for fire doors exceeding the size for which label service is available.

Thermal Insulation
Sound Rating Test

Certification or test report for thermal insulated, sound rated doors listing the type of hardware used to achieve the rating.

SD-10 Operation and Maintenance Data

Door Description

Information bound in manual form consisting of manufacturer's safety precautions, preventative maintenance and schedules, troubleshooting procedures, special tools, parts list, and spare parts data. All material shall be cross referenced to the door designations shown on the drawings.

1.3 DOOR DESCRIPTION

Structural steel doors shall be flush mounted in frames. Hollow metal doors shall be flush mounted in frames. Doors shall be the manually operated, side hinged, swinging type. Each door assembly shall include the door, frame, anchors, hardware, and accessories and shall be provided by a single manufacturer. Frames and anchors shall be capable of transferring blast and rebound reactions to the adjacent supporting structure. Resistance to blast shall be demonstrated either by design calculations or tests on prototype door assemblies.

1.3.1 Design Requirements

1.3.1.1 Rebound Resistance

Rebound resistance shall be the specified or indicated percentage of the door resistance at initial peak response.

1.4 QUALIFICATIONS

Welders, welding operators, and weld inspectors shall be qualified in accordance with AWS D1.1/D1.1M except that welders performing arc welding of steel sheet and strip shall be qualified in accordance with AWS D1.3/D1.3M and welders and weld operators performing welding of reinforcing bars shall be qualified in accordance with AWS D1.4/D1.4M.

1.5 DELIVERY AND STORAGE

Door assemblies delivered and placed in storage shall be stored with protection from weather and dirt, dust, and contaminants.

1.6 WARRANTY

Manufacturer's written warranty covering the blast door assembly for 2 years after acceptance by the Government shall be furnished. Warranty shall provide for repair and replacement of the blast door assembly and individual hardware and accessory items in the event of malfunction due to defects in design, materials, and workmanship except that the warranty need not cover finishes provided by others.

PART 2 PRODUCTS

2.1 MATERIALS

Only structural quality steel materials for which tension properties have been obtained shall be used to resist blast except that commercial quality steel sheet and strip shall be permitted for prototype tested hollow metal doors. Steel used in the door, door frame, and door frame anchors and non stainless steel fasteners that resist blast shall be selected from the materials specified.

2.1.1 Structural Tubing

Structural tubing shall conform to ASTM A 500/A 500M, ASTM A 501, or ASTM A 618/A 618M.

2.1.2 Structural Steel

Structural steel bars, plates, and shapes shall conform to ASTM A 36/A 36M, ASTM A 242/A 242M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M. Quenched and tempered steel plate shall conform to ASTM A 514/A 514M.

2.1.3 Steel Sheet and Strip

Steel sheet and strip shall conform to ASTM A 653/A 653M, Grades A, B, C, D, and F; ASTM A 653/A 653M; ASTM A 606; or ASTM A 792/A 792M, Grades 33, 37, 40, and 50.

2.1.4 Fasteners

Steel studs and bolts shall conform to ASTM A 307, ASTM A 325, ASTM A 354, ASTM A 449, or ASTM A 490 as applicable. Steel nuts shall conform to ASTM A 563. Hardened circular, beveled, and clipped washers shall conform to ASTM F 436. Steel hex cap screws shall conform to ASTM F 568M. Steel socket-headed cap screws shall conform to ASTM A 574. Steel button and flat-headed countersunk cap screws shall conform to ASTM F 835.

2.2 HARDWARE

2.2.1 Hinges

2.2.1.1 General Requirements

Hinges shall be specially manufactured to support the door and to resist blast induced loading. The number of hinges shall be determined by the blast door manufacturer. Welds used in hinges shall be continuous. Hinges shall be attached to the door and frame using mechanical fasteners except that full surface hinges for doors with locks shall be attached to the door and frame by welding or approved tamper-resistant mechanical fasteners and hinges for doors with locks shall have approved nonremovable pins. Load ratings and fatigue life for ball and roller bearings shall be determined in accordance with ABMA 9 and ABMA 11 as applicable and, unless otherwise approved, the bearing steel shall conform to ASTM A 534. Hinges shall be capable of operating for the minimum number of cycles specified without failure or excessive wear under the door service loads where one cycle consists of swinging the door back and forth between the normal closed position and the 90-degree open position, where failure or excessive wear means that the latches do not seat properly or the door does not swing smoothly due to hinge failure or wear, and where door service loads consist of the door weight plus any loads produced by hardware. Rolling bearings shall be factory grease lubricated and either sealed or provided with easily accessible lubrication fittings.

2.2.1.1 Hinge Description

Hinge Type 1 shall be capable of smooth operation for a minimum of 250,000 cycles. This type of hinge shall be provided with structural quality steel pins and leafs and either rolling bearings in both the thrust and radial directions or hardened steel washer (disc) thrust bearings and rolling

radial bearings except that rolling thrust bearings and metallic journal radial bearings shall be permitted for hollow metal doors when the specified overpressure is less than 3 psi. Hinge Type 2 shall be smooth operating and shall be provided with structural quality steel pins and leafs, steel base washer (disc) thrust bearings, and metallic journal radial bearings or other approved non rolling type bearings. Hinge Type 3 shall be provided with metallic bearings.

2.2.2 Latching System

2.2.2.1 Latching Points

The number of latching points shall be determined by the door manufacturer. For multiple latching points, latching points can be provided at the head, sill, and jambs. For jamb latching points, latching points shall be provided at the jambs only.

2.2.2.2 Latching System Operation

Latching systems shall be capable of operating for the same number of cycles specified for the door hinges where one latch operating cycle consists of engaging and releasing using the handle. Latches shall remain engaged until manually released and shall not release under blast loads or rebound. Manually operated latches shall remain in the released position until manually engaged. Self-latching latches shall provide self-activating engagement when the door is swung to the normal closed position. Handles shall release latches under a clockwise motion.

2.2.2.3 Latching Mechanism

Latching mechanisms and latches for structural steel doors shall be mounted on the seating face of the door. Latching mechanisms for hollow metal doors shall be mounted on the seating face of the door and safety covered. Unless otherwise approved, latch handle axles (spindles) for structural steel doors and reinforced concrete doors shall extend through the blast load carrying portion of the door and shall be provided with suitable metallic journal bearings. Latch handle axles shall be manufactured of hardened steel or stainless steel, and axles requiring lubrication shall be provided with easily accessible lubrication fittings.

2.2.2.4 Safety Cover

Safety covers shall consist of steel housings that enclose the latching mechanism such that only the operating rods are exposed.

2.2.2.5 Cover Plate

Cover plates for structural steel doors shall be manufactured of minimum 1/4 inch thick plate and shall enclose the entire latching mechanism.

2.2.2.6 Latches

Latches (latch bolts) shall be manufactured of structural quality steel and the latch bolt throw shall not be less than 3/4 inch. Latch bolts shall be the sliding type in which the latch bolt slides into a matching strike in the door frame or the lever type in which the latch bolt rotates into a groove in the frame as specified or indicated except that latches for doors with mortise lock and latch sets and exit devices shall be the sliding type. Manually operated latches shall draw the door toward the frame

during latching.

2.2.2.7 Handle

Handles for doors without locks shall be manufactured of steel castings, forgings, pipe, round tubing, bar, or plate and shall be one piece or have welded joints except that wheel handles can be manufactured of aluminum castings. Handles for doors with mortise lock and latch sets shall be manufactured of steel castings or stainless steel. Latch handles shall be firmly fastened to axles. Lever handles shall be perpendicular to the door edge when latches are engaged. Single lever handles shall be located at the stile opposite the hinges. Wheel and spoke lever, Spoke lever handles shall be located approximately halfway between the stiles.

2.2.3 Mortise Lock and Latch Set

Lever handles shall release latches using a torque not exceeding 27 lb-inch. Latches (latch bolts) shall be located at the stiles and operated from a single lever handle. Only one deadbolt shall be provided. The deadbolt shall be manufactured of structural quality steel and the deadbolt throw shall not be less than 1 inch. Mortise locks shall be provided with armored fronts. The function numbers for mortise locks shall be as defined in BHMA A156.13.

2.2.4 Keying

Keying shall conform to Section 08 71 00 DOOR HARDWARE. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Unless otherwise specified, two change keys shall be provided for each lock. Locks shall be furnished with the manufacturer's standard construction key system.

2.2.5 Exit Device

Latches (latch bolts) shall release by depressing the actuation bar using a force of not more than 15 lbf applied perpendicular to the door in the swing direction. The exit device shall conform to the finish test values specified in BHMA A156.3 and shall be of stainless steel construction and plain design with straight, beveled, or smoothly rounded sides, corners, and edges. A touch bar may be provided in lieu of a conventional actuation bar (cross bar). The function numbers for exit devices shall be as defined in BHMA A156.3.

2.2.6 Door Stop

Door stops shall be designed to resist the impact of the door. The stop shall not scratch or scar the door finish when the door is opened against the stop.

2.2.7 Surface Door Closer

The surface door closer shall conform to BHMA A156.4. The size and grade shall be selected by the door manufacturer.

2.2.8 Overhead Door Holder

Overhead door holder shall be surface mounted. The holder shall have a spring or other device to cushion the door action and shall limit the door swing at 85, 110 degrees. The holder shall have a built-in, hold-open

capability at the swing limit specified. Overhead door holders for hollow metal doors weighing less than 200 pounds shall conform to BHMA A156.8.

2.2.9 Gasket Seal

Sealed doors shall have the full door perimeter and all door penetrations sealed. Perimeter seals shall be the rubber gasket type. Gaskets shall be removable, capable of sealing the mating surfaces, and resistant to the atmospheric environment. One spare set of gasket seals shall be provided for each door assembly for which gasket seals are specified.

2.2.10 Door Silencer

Rubber door silencers shall cushion the impact of the door against the frame so that steel-to-steel contact is not made during closing.

2.2.11 Optical Device

The optical device (spy hole) shall be wide angle and shall not be breeched or dislodged by the specified or indicated blast overpressure. The device shall permit observation from the seating face of the door and shall be located approximately 5 feet above the seating side floor and approximately centered between the stiles.

2.3 ACCESSORIES

2.3.1 Subframe

At the Contractor's option, a subframe can be provided and built into the structure prior to installation of the frame. The subframe and subframe anchors shall be capable of transferring blast and rebound reactions to the adjacent structure, and the frame shall be capable of transferring these reactions to the subframe. The subframe shall be fabricated in the same manner specified for the frame.

2.3.2 Nameplate

Each door assembly shall have a permanently affixed nameplate that displays the manufacturer's name, place and year of manufacture, and the applicable peak overpressure, impulse, and rebound rating.

2.3.3 Removable Threshold

The sill shall be flush with the adjacent floor when the threshold is removed. The removable threshold shall be attached using approved countersunk mechanical fasteners.

2.3.4 Ramp

The ramp shall be structural steel, portable, and weigh not more than 200 pounds. The ramp shall be of sufficient length to extend the full door opening width and shall have the profile indicated. The ramp shall be capable of supporting the wheel load indicated.

2.3.5 Self-Rescue Kit

Self-rescue kits shall contain illustrated instructions, nonadjustable wrenches, screwdrivers, jacks, and all other tools required to open the blast door from the seating face to a width of at least 12 inches. The

jack capacity shall not be less than 75,000 lbf. Tools shall be securely mounted in a steel frame using wing nuts or other approved fasteners. The self-rescue kit frame shall be fabricated in the same manner specified for the door frame and shall be securely anchored to the wall at the location indicated or as directed.

2.4 FABRICATION

2.4.1 Shop Assembly

Welding shall be in accordance with AWS D1.1/D1.1M except that arc welding of steel sheet and strip shall be in accordance with AWS D1.3/D1.3M and welding of concrete reinforcing bars shall be in accordance with AWS D1.4/D1.4M. Stainless steel shall be welded using electrodes conforming to AWS A5.4/A5.4M. Structural steel doors shall be of welded construction. Fabricated steel shall be well-formed to shape and size, with sharp lines and angles. Intermediate and corner joints shall be coped or mitered. Exposed welds shall be dressed smooth. The stiles and top of built-up structural steel doors shall be closed using channel shapes or plates. When feasible, faceplates for structural steel doors shall be one piece. When one-piece faceplates are not feasible, plates shall be joined using full penetration groove weld butt joints or other approved welds. Reinforced concrete doors shall be closed at the edges with structural steel channels or plates and latch housings shall be mortised. Lap splices shall not be used for flexural reinforcing bars. Spall plates shall be one piece, covering the entire concrete surface on the seating face of the door, and shall be securely welded to the door edges. Spall plates shall not be less than 1/4 inch thick. Faceplated reinforced concrete doors shall be provided with one-piece faceplates on both door faces. Faceplates shall cover the entire concrete surface and shall be securely welded at the door edges. Faceplates shall be not less than 3/8 inch thick. Hollow metal door frames shall be pressed steel or structural steel with welded joints. Steel frames or subframes installed in masonry walls shall be provided with adjustable anchors. Hollow metal doors shall be of unitized grid construction with welded grid junctions and shall have flat, one-piece face sheets spot welded to each face of the grid system. The edges of hollow metal doors shall be closed with seams continuously welded. Hollow metal doors shall be neat in appearance, free from warpage and buckle, and suitable reinforcing shall be provided for hardware.

2.4.2 Mullion

Mullions for double doors shall be fabricated in the same manner specified for frames. Fixed mullions shall be welded to the frame. Removable mullions shall be attached to the frame with mechanical fasteners that are accessible for mullion removal or, in lieu of the removable mullion, an astragal shall be provided at the seating face of the inactive door leaf. Doors shall seat directly against the mullion, and the mullion or astragal shall be capable of transferring the door reactions to the frame.

2.4.3 Thermal Insulation

The interior cells between the unitized grid shall be completely filled with thermal insulation material. The U value through the door (panel) shall not exceed 0.24 Btu per square foot per hour per degree F.

2.4.4 Shop Finishing

Shop priming of steel surfaces shall conform to Section 09 90 00 PAINTS AND

COATINGS, except that surfaces that will be embedded in concrete need not be primed and hollow metal doors shall be either dipped in primer after welding is completed, or exposed surfaces shall be primed and interior surfaces coated with an approved rust inhibitor. Galvanizing of doors and frames shall conform to ASTM A 123/A 123M or other approved methods. Surfaces that will be embedded in concrete need not be galvanized and the interior of hollow metal doors may be treated with an approved rust inhibitor in lieu of galvanizing. Galvanizing of exposed portions of concrete anchors, non stainless steel fasteners, and hardware other than factory finished hardware shall conform to ASTM A 153/A 153M or other approved methods.

2.4.5 Clearance

The clearance between the seated steel surfaces of structural steel doors and frames shall not exceed 1/16 inch. The lateral clearance between flush mounted structural steel doors and frames shall not exceed 1/4 inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed 1/2 inch. The lateral clearance between hollow metal doors and frames shall not exceed 1/8 inch at the head and jambs and the clearance between the meeting edges of pairs of doors shall not exceed 1/4 inch. The clearance between the door bottom and threshold shall not exceed 3/4 inch.

2.5 BLAST DOOR ASSEMBLIES

2.5.1 Door; Steel

2.5.1.1 Type

Type shall be structural steel, double structural steel door with fixed or removable mullion, galvanized, and fire-rated.

2.5.1.2 Overpressure

Overpressure shall be ____ psi with a _____ millisecond duration in the seating, unseating direction and _____ psi with a ____ millisecond duration in the unseating direction. The shock and gas overpressure, overpressure waveform shall be as indicated.

2.5.1.3 Fragment

The fragment shall be _____ ounces with a velocity of _____ fps and impact normal to, at an angle of _____ degrees measured from the door face. Protection from fragments shall be provided by steel plate not less than _____ inches in thickness.

2.5.1.4 Rebound

Rebound resistance shall be 50, 100 percent.

2.5.1.5 Deformation Limits

The ductility ratio shall not exceed 10 and the support rotation shall not exceed 2 degrees, 20 and the support rotation shall not exceed 12 degrees.

2.5.1.6 Hardware

Full surface hinges shall be Type 1, 2, 3. Multiple, Jamb, latching points

and multiple lever handles, or a single lever handle, or a wheel handle, or a spoke lever handle, operated from the seating face and opposite the seating face with manual, self-latching latch engagement and either sliding or lever latch bolts shall be provided. The latching mechanism shall be safety or cover plated. A Type I, II, III straight steel bar door pull, and padlock, shrouded padlock, and hasp, high security hasp, shrouded hasp, and door stop, and surface door closer, overhead door holder, and gasket seals door silencer, and optical device shall be provided.

2.5.1.7 Operating Forces

Maximum operating forces shall be 30 lbf to set the door in motion and 20 lbf to swing the door. Maximum force to engage and release latches shall be 30 lbf. Operating forces shall conform to NFPA 101.

2.5.1.8 Accessories

A removable threshold or ramp and self-rescue kit shall be provided.

2.5.2 Rebound

Rebound resistance shall be 20, 100 percent.

2.5.3 Overpressure

Overpressure shall be _____ psi in the seating, unseating direction and _____ psi in the unseating direction.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

2.6.1 Prototype Static Test

Static tests on prototype door assemblies shall demonstrate that the door will resist the blast overpressure. Static tests will be accepted only if the door and frame proposed are manufactured using the same materials, dimensions, and tolerances as those in the prototype static test and the static overpressure used in the test is at least two times the blast overpressure. Static test reports shall be supplemented with calculations that demonstrate rebound resistance when rebound is not tested.

2.6.2 Prototype Blast Test

Blast tests on the prototype door assembly shall demonstrate that the door will resist the overpressure waveform. Blast tests will be accepted only if the door and frame proposed are manufactured using the same materials, dimensions, and tolerances as those in the prototype blast tests. The rise time of the test waveform shall be zero or subject to approval. For an overpressure with infinite duration, the overpressure used in the test shall be not less than that specified or indicated for a duration equal to at least five times the natural period of the door and the test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance. For overpressure with finite duration, the overpressure waveform used in the test shall exceed the overpressure waveform in both peak overpressure and impulse and the blast test report shall be supplemented with calculations that demonstrate the specified or indicated rebound resistance when the positive phase waveform duration in the test exceeds the positive phase duration specified or indicated.

2.6.3 Shop Operating Test

Prior to shipment, each door assembly shall be fully erected in a supporting structure and tested for proper operation. Such testing shall include opening, closing, and operating all moving parts to ensure smooth operation and proper clearance, fit, and seating. The operating forces and opening and closing times shall be determined. The Contracting Officer shall be notified at least 7 calendar days prior to the start of testing and all doors, door, and shall be tested in the presence of the Contracting Officer. A test report shall be prepared and three copies furnished within 7 calendar days after testing.

2.6.4 Air Leakage Test

Each door assembly for which door seals or thermal insulation are, is specified shall be factory tested for air leakage rate in accordance with ASTM E 283. The rate of air leakage per unit length of crack shall not exceed 0.20 cfm using a pressure difference of 1.57 psf. Prototype tests can be substituted for door assembly tests when the prototype door, frame, and hardware tested are equivalent to that provided or when otherwise approved.

2.6.5 Sound Rating Test

The sound transmission class (STC) rating shall be determined in accordance with ASTM E 90.

2.6.6 Fire Rating Test and Inspection

Fire-rated door assemblies shall bear the listing identification label of the UL, or other nationally recognized testing laboratory qualified to perform tests of fire door assemblies in accordance with NFPA 252 and having a listing for the tested assemblies. Doors exceeding the size for which listing label service is offered shall be inspected in accordance with NFPA 80, NFPA 80A, and NFPA 101.

PART 3 EXECUTION

3.1 INSTALLATION

Doors and frames shall be installed in accordance with the manufacturer's written instructions. Pressed steel frames for hollow metal doors shall be fully grouted. Exposed surfaces shall be finish painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Galvanized surfaces damaged prior to final acceptance shall be repaired in accordance with ASTM A 780 to the same thickness as the original galvanizing.

3.2 TESTS

After installation is completed, each door shall be field tested for operation, clearance, fit, and seating by operating the door and hardware through at least 10 operating cycles. Door and hardware operation shall be tested using the forces specified. Personnel and equipment required to perform field testing shall be provided by the Contractor. Unless waived, all field tests shall be performed in the presence of the Contracting Officer. After testing is completed, test reports shall be prepared and three copies furnished.

3.3 MANUFACTURER'S FIELD SERVICE

Installation and testing of door assemblies shall be under the supervision of the door manufacturer's erection engineer. Upon completion of the work, and at a time designated by the Contracting Officer, the services of one engineer and other technical personnel as required shall be provided for a period of not less than 4 hours to instruct Government personnel in the operation and maintenance of the blast doors and all other items furnished under this specification section. The instructions shall also include use of the operation and maintenance manual. The instructions shall include videotapes. An instruction outline and procedure shall be submitted and approved prior to scheduling the instruction. One copy of all instruction material shall be provided at the time of instruction.

-- End of Section --

SECTION 08 41 00

ALUMINUM ENTRANCES AND STOREFRONTS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA WSG-1	(1995) Window Selection Guide
AAMA CW-10	(1997) Curtain Wall Manual # 10 Care and Handling of Architectural Aluminum from Shop to Site
AAMA 501	(1994; 501.1; 501.2) Methods of Test for Exterior Walls
AAMA 603	(1998) Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum
AAMA 605	(1998) Voluntary Specifications, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 606.1	(1976) Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum
AAMA 607.1	(1977) Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum
AAMA 608.1	(1977) Voluntary Guide Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum
AAMA SFM-1	Aluminum Storefront and Entrance Manual

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A117.1	Safety Standards for the Handicapped
ANSI/ASTM A386	Zinc Coating (Hot Dip) on Assembled Steel Products

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1997el) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

1.2 SUMMARY

This section includes:

a. Aluminum doors and frames

b. Vision glass, glass and insulated metal infill panels

c. Finish hardware

d. Integral air and vapor barrier

e. Perimeter sealant

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

a. Section 08 71 00 "Door Hardware": Hardware items other than specified in this section.

1.4 RELATED SECTIONS

a. Section 05 50 00, "Metal: Miscellaneous and Fabrications": Metal fabricated
attachment devices.

b. Section 07 92 00, "Joint Sealants": System perimeter sealant and back-up materials.

c. Section 08 51 13.00, "Aluminum Windows": Operable sash within glazing system.

d. Section 08 71 00, "Door Hardware: Mortised hardware reinforcement requirements affecting framing members.

e. Section 09 90 00, "Paints and Coatings": Field painting of interior surface of infill panel and exterior surfaces.

1.5 SYSTEM DESCRIPTION

Aluminum entrances and storefront system includes tubular aluminum sections with supplementary internal support framing, shop fabricated, factory pre-finished, vision glass and insulated metal panel infill, related flashings, anchorage and attachment devices.

1.6 PERFORMANCE REQUIREMENTS

a. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with code, to design pressure of _____ lb/sq ft (_____KPa) and as measured in accordance with ASTM E 330.

b. Limit mullion deflection to lexure limit of glass, 3/4 inch (19 mm) 1/200; with full recovery of glazing materials.

c. System to accommodate, without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.

d. Limit air leakage through assembly to 0.06 cfm/min/sq ft (0.0003 cu m/s/sq m) of wall area, measured at a reference differential pressure across assembly of 1.57 psf (75 Pa) as measured in accordance with AAMA 501, ASTM E 283.

e. Vapor Seal with Interior Atmospheric Pressure of 1 inch (25 mm) sp, 72 degrees F (22 degrees C), 40 Percent RH: No failure.

** OR **

e. Water Leakage: None, when measured in accordance with AAMA 501, ASTM E 331 with a test pressure difference of 2.86 lbf/sq ft (12\36.85 N/sq m).

f. Maintain continuous air and vapor barrier throughout assembly, primarily in line with inside pane of glass and inner sheet of infill panel and heel bead of glazing compound.

g. System to provide for expansion and contraction within system components caused by a cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental affect to system components.

h. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.6 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Components

Indicate system dimensions, framed opening requirements and tolerances, affected related work and expansion and contraction joint location and details.

SD-03 Product Data

Components

Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

SD-04 Samples

Components

Submit two samples ____x____ inches (____x____ mm) in size illustrating pre-finished aluminum surface, glass infill panels, and glazing materials.

SD-07 Certificates

Components

Certify that products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

Perform work in accordance with AAMA SFM-1 and AAMA WSG-1. Conform to requirements of ANSI A117.1.

1.8 QUALIFICATIONS

Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum five years documented experience.

1.9 PRE-INSTALLATION CONFERENCE

Convene two weeks prior to commencing work of this Section, under Section 01 11 00, "Summary of Work."

1.10 DELIVERY, STORAGE, AND HANDLING

Handle work of this section in accordance with AAMA CW-10. Protect pre-finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.11 ENVIRONMENTAL REQUIREMENTS

Do not install sealants when ambient temperature is less than 40 degrees F during and 48 hours after installation.

1.12 FIELD MEASUREMENTS

Verify that field measurements are as indicated on shop drawings.

1.13 COORDINATION

Coordinate work under provisions of Section 01 11 00, "Summary of Work." Coordinate the work with installation of air and vapor barrier and components or materials.

1.14 WARRANTY

Provide three year warranty under provisions of Section 01 77 00, "Closeout Procedures." Include coverage for complete system for failure to meet specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURER'S

a. _____ Product _____

b. Other acceptable manufacturer's offering equivalent products:

(1) _____ Product _____

(2) _____ Product _____

(3) _____ Product _____

c. Substitutions: Under provisions of Section _____.

(1) _____

2.2 MATERIALS

2.2.1 Extruded Aluminum

ASTM B 221; 6063 alloy, T-5 temper.

2.2.2 Sheet Aluminum

ASTM B 209; _____ alloy, _____ temper.

2.2.3 Fasteners

Stainless steel.

2.3 COMPONENTS

2.3.1 Frame

____ x ____ nominal dimension; thermally broken with interior tubular section insulated from exterior; flush, applied, glazing stops; drainage holes; internal weep drainage system. Frames for interior glazing need not to be thermally broken.

2.3.2 Reinforced, Structural Mullion

____ x ____ inch nominal dimension; profile of extruded, sheet, aluminum, cladding with internal reinforcement of shaped steel structural section.

2.3.3 Doors

2 inches thick, __ inch wide top rail, ____ inch wide vertical stiles, ____ inch wide bottom rail; square, bevelled, glazing stops.

2.3.4 Infill Panel

Internally reinforced, glazing edge sealed, unsealed, permitting internal air movement to glazing space, outside air barrier line, structurally sufficient to support wall fin radiation saddles:

a. Outer Face: _____ inch thick aluminum.

b. Core: Glass fiber, Rigid polystyrene, Rigid polyurethane insulation core with R value of _____ (RSI of _____.

c. Inner Face: ____ inch thick aluminum.

2.3.5 Flashings

____ inch thick aluminum, stainless steel, galvanized steel finish as selected, to match mullion sections where exposed.

2.3.6 Operable Sash

Specified in Section 08 51 13.00, "Aluminum Windows."

2.3.7 Air and Vapor Barrier

Specified in Section _____,_____.

2.4 GLASS AND GLAZING MATERIALS

As specified in Section 08 81 00, "Glazing." Types as described below:

a. Glass in exterior lights: Type _____

b. Glass in interior lights: Type _____

c. Glass in door Lights: Type _____

d. Glass infill panels: Type _____

2.5 SEALANT MATERIALS

As specified in Section 07 92 00, "Joint Sealants" of types described below:

a. Perimeter sealant: Type _____

b. Sealant Used Within System (Not used for glazing): _____

2.6 HARDWARE

2.6.1 Weatherstripping, Sill Sweep Strip, Thresholds, Hinges, Push/Pull Handles, Panic Device, Closer

Manufacturer's standard type to suit application, _____ finish.

- OR -

Wool, _____ pile, continuous and replaceable.

2.6.2 Sill Sweep Strips

Retracting, resilient seal type, of neoprene, _____ compound.

2.6.3 Threshold

Extruded aluminum, one piece per door opening, ribbed, non-slip surface

2.6.4 Hinges

Center, Swing clear, butt type.

2.6.5 Pivots

Center, Offset, type.

2.6.6 Push/Pull

_____ style.

2.6.7 Panic Device

_____.

2.6.8 Closer

_____.

2.6.9 Latch Handle

_____.

2.6.10 Security Lock, Deadlatch

_____.

2.6.11 Cylinder Lock, Thumb Turn

_____.

2.6.12 Electric Strike, Strike Keeper

_____.

2.7 FABRICATION

2.7.1 Components

Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

2.7.2 Joint and Corner Fitting

Accurately fit and secure joints and corners. Make joints flush, hairline,

and weatherproof.

2.7.3 Anchors

Prepare components to receive anchor devices. Fabricate anchors.

2.7.4 Fasteners

Arrange fasteners and attachments to conceal from view.

2.7.5 Horizontal Head Rail

Reinforce interior horizontal head rail to receive drapery blind track brackets and attachments.

2.7.6 Door Hardware

Prepare components with internal reinforcement for door hardware and door operator hinge hardware.

2.7.7 Framing Members

Reinforce framing members for imposed loads.

2.8 FINISHES

2.8.1 Finish Coatings

Conform to AAMA 603, AAMA 605, AAMA 606.1, AAMA 607.1, AAMA 608.1.

2.8.2 Exterior Exposed Aluminum Surfaces

AAMA A41, A42, A43, A44 anodized to 215-R1 thickness, prepared with a mechanical M_____, chemical C_____ pre-treatment, anodized to clear, _____ color.

- OR -

Exterior, Hardcoat, Two step anodized to clear, _____ color, to 0.0007 inch thickness. Organic coating to _____ color as selected.

2.8.3 Exterior Exposed Infill Panel Surfaces

AAMA A41, A42, A43, A44 anodized to 215-R1 thickness, prepared with a mechanical M____, chemical C_____ pre-treatment, anodized to clear color.

- OR -

Exterior, Hardcoat, Two step anodized to clear color, to 0.0007 inch thickness. Organic coating to color as selected.

2.8.4 Interior Exposed Aluminum Surfaces

AAMA A41, A42, A43, A44 anodized to 215-R1 thickness, prepared with a mechanical M____, chemical C____, pre-treatment, anodized to clear color.

- OR -

Interior, Hardcoat, Two step anodized to clear color, to 0.0007 inch thickness. Organic coating to color as selected.

2.8.5 Interior Surface of Infill Panel Surfaces

Field painted in accordance with Section 09 90 00, "Paints and Coatings." Anodized to clear color. Enamelled to color as selected.

2.8.6 Concealed Steel Items

Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq ft. Primed with iron oxide paint.

2.8.7 Surfaces In Contact With Cementitious or Dissimilar Materials

Apply one coat coats of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Site Opening Conditions

Verify site opening conditions under provisions of Section _____, "_____."

3.1.2 Dimensions, Tolerances, and Attachment Methods

Verify dimensions, tolerances, and method of attachment with other work.

3.1.3 Wall Openings

Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

3.2 INSTALLATION

3.2.1 Wall System

Install wall system in accordance with manufacturer's instructions and AAMA CW-10.

3.2.2 Attachment and Alignment

Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities. Provide alignment attachments and shims to permanently fasten system to building structure. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work. Provide thermal isolation where components penetrate or disrupt building insulation. Install sill flashings. Coordinate attachment and seal of perimeter air and vapor barrier materials. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier. Install operating sash. Install flashings and _____, Set thresholds in bed of mastic and secure.

3.2.3 Hardware

Install hardware using templates provided. Refer to Section 08 71 00, "Door Hardware" for installation requirements.

3.2.4 Glass

Install glass and infill panels in accordance with Section 08 81 00, "Glazing" to glazing method required to achieve performance criteria exterior wet/dry, dry method of glazing.

3.2.5 Sealants

Install perimeter sealant to method required to achieve performance criteria. Type _____, backing materials, and installation criteria in accordance with Section 07 92 00, "Joint Sealants."

3.3 TOLERANCES

a. Maximum Variation From Plumb: 0.06 inches every 3 feet non-cumulative or 1/16 inches per 10 feet, whichever is less.

b. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 ADJUSTING

Adjust operating hardware and sash for smooth operation.

3.5 CLEANING

Remove protective material from pre-finished aluminum surfaces. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dire from corners. Wipe surfaces clean. Remove excess sealant by method acceptable to sealant manufacturer.

3.6 PROTECTION OF FINISHED WORK

Protect finished work from damage.

3.7 SCHEDULES

a. Main Entrance Wall and Doors (Opening No. M101): 1 3/4 x 4 inch sections, flush glazing, thermally broken, Dark Bronze anodized finish; NoBrand No. 222 entrance doors with same finish, hardware specified in Section 08 71 00, "Door Hardware." Automatic entrance door operators specified in Section _____, "_____."

b. Main Entrance Vestibule Wall and Doors (Opening No. M102): 1 3/4 x 4 inch sections, flush glazing, non-thermally broken, Light Bronze anodized finish, NoBrand #333 entrance doors with same finish, hardware specified in Section _____, "_____."

c. Office Wall and Doors (Opening No. M113 and M115): 1 3/4 x 3 1/2 inch sections, Clean anodized finish, wood doors specified in Section _____, "_____"; 1 pair butt hinges, dull chrome handset.

-- End of Section --

SECTION 08 51 13

ALUMINUM WINDOWS

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(2005) Standard Specification for Windows, Doors, and Unit Skylights
AAMA 1302.5	(1976) Voluntary Specifications for Forced-Entry Resistant Aluminum Prime Windows
AAMA 1503	(1998) Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
AAMA 2603	(2002) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 611	(1998) Voluntary Specification for Anodized Architectural Aluminum
AAMA 701	(2004) Voluntary Specification for Pile Weather Strip
AAMA 902	(1999) Voluntary Specification for Sash Balances
AAMA WSG.1	(1995) Window Selection Guide

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1011/A 1011M	(2007) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 36/A 36M	(2005) Standard Specification for Carbon

	Structural Steel
ASTM A 501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM B 117	(2007) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 244	(1997; R 2002) Standard Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B 584	(2006a) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1593	(1999) Standard Specification for Non-rigid Vinyl Chloride Plastic Film and Sheeting
ASTM D 1972	(1997; R 2005) Standard Practice for Generic Marking of Plastic Products
ASTM D 3656	(2004) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM E 2016	(2006) Standard Specification for Industrial Woven Wire Cloth
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 331	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain

	Walls by Uniform Static Air Pressure Difference
ASTM E 413	(2004) Rating Sound Insulation
ASTM E 547	(2000) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference
ASTM E 90	(2004) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.16	(2002) Auxiliary Hardware

GREEN SEAL (GS)

GS-36	(2000) Commercial Adhesives

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2004) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2004) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2005; Errata 2006; TIA 2006; TIA 2006) Life Safety Code, 2006 Edition

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

AAMA/NWWDA 101/I.S.2	(1997) Voluntary Guide Specifications for Aluminum, Poly(Vinyl Chloride)(PVC) and Wood Windows and Glass Doors

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA 1004	(1987; R 1998) Aluminum Tubular Frame Screens for Windows

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 101	(1982) Paint Specification No. 101 Aluminum Alkyd Paint Leafing (Type I) and Non-Leafing (Type II)

SSPC Paint 12 (1982; E 2000) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 CERTIFICATION

Each prime window unit must bear the AAMA Label warranting that the product complies with AAMA 101. Certified test reports attesting that the prime window units meet the requirements of AAMA 101, including test size, will be acceptable in lieu of product labeling.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Windows

Fabrication Drawings

SD-03 Product Data

Windows

Hardware

Fasteners (LEED)

Aluminum Windows

Frames

Aluminum Sills

THERMAL-BARRIER WINDOWS

MULLIONS

SHADE SCREENS

WINDOW CLEANERS' BOLTS

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar

value of products included in project.

Screens

Weatherstripping

Accessories

Adhesives; (LEED)

Submit manufacturer's product data, indicating VOC content.

Windows

Submit documentation for Energy Star qualifications.

Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

SD-04 Samples

Finish Sample

Window Sample

SD-05 Design Data

Structural calculations for deflection

Design Analysis

SD-06 Test Reports

Minimum condensation resistance factor

Resistance to forced entry

SD-10 Operation and Maintenance Data

Windows, Data Package 1

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

1.4 QUALITY ASSURANCE

1.4.1 Shop Drawing Requirements

Provide drawings that indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, mullion details, method and materials for weatherstripping, method of attaching screens, material and method of attaching subframes, stools, casings, sills, trim, window cleaner anchors, installation details, and other related items.

1.4.2 Sample Requirements

1.4.2.1 Finish Sample Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

1.4.2.2 Window Sample Requirements

Submit one full-size window of each type proposed for use, complete with AAMA Label, glazing, hardware, anchors, and other accessories. Where screens or weatherstripping is required, fit sample windows with such items that are to be used. After approval, install each sample in work, clearly identified, and record its location. Screening must conform to ASTM D 3656.

Submit one full-size corner of each window type proposed for use. Where screens or weatherstripping is required, fit sample with such items that are to be used.

1.5 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

1.6 PROTECTION

Protect finished surfaces during shipping and handling using the manufacturer's standard method. Do not apply coatings or lacquers to surfaces to which calking and glazing compounds must adhere.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Window materials may be locally available.

1.7.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

1.7.3 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D 1972. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.
a. Type 1: Polyethylene Terephthalate (PET, PETE).
b. Type 2: High Density Polyethylene (HDPE).
c. Type 3: Vinyl (Polyvinyl Chloride or PVC).
d. Type 4: Low Density Polyethylene (LDPE).
e. Type 5: Polypropylene (PP).
f. Type 6: Polystyrene (PS).
g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

1.8 FIELD MEASUREMENTS

Take field measurements prior to preparation of the drawings and fabrication.

1.9 PERFORMANCE REQUIREMENTS

1.9.1 Minimum Antiterrorism Performance Criteria

Windows must meet the minimum antiterrorism performance criteria as specified in the paragraphs below.

1.9.1.1 Glazing

Glazing must have laminated glass as specified in Section 08 81 00 GLAZING.

1.9.1.2 Aluminum Window Frames

Restrict aluminum framing members deflections of edges of glazing they support to L/160 under an equivalent 3-second duration loading of ____ pounds per square foot (psf), where L denotes the length of the glazing supported edge. (L is to be based on edge length of glazing in frame and not on the distance between anchors that fasten frame to the structure.)

The glazing frame bite for the window frames must be adequate to accept the width of structural silicone sealant or glazing tape as specified in paragraph "Provisions for Glazing" below.

1.9.1.3 Window Frame Anchors

Fasten window frames to the supporting structure with anchors designed to resist forces generated by a 3-second duration load of _____ pounds per square foot (psf) acting on the entire window unit.

1.9.2 Wind Loading Design Pressure

Design window components, including mullions, hardware, and anchors, to withstand a wind-loading design pressure of at least _____ pounds per square foot (psf).

1.9.3 Tests

Test windows proposed for use in accordance with AAMA/NWWDA 101/I.S.2 for the particular type and quality window specified.

Perform tests by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Submit the results of the tests as certified laboratory reports required herein.

Minimum design load for a uniform-load structural test must be 50 psf.

Test projected windows in accordance with the applicable portions of the AAMA WSG.1 for air infiltration, water resistance, uniform-load deflection, and uniform-load structural test.

Test double-hung windows in accordance with the applicable portions of the AAMA WSG.1 for air infiltration, water resistance, uniform-load deflection, and uniform-load structural test.

1.10 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete window assembly including hardware, weatherstripping, and subframe assembly details.

1.11 WINDOW PERFORMANCE

Aluminum windows must meet the following performance requirements. Perform testing requirements by an independent testing laboratory or agency.

1.11.1 Structural Performance

Structural test pressures on window units must be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there will be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There must be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA 101 for the window types and classification specified in this section.

1.11.2 Air Infiltration

Air infiltration must not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 283.

1.11.3 Water Penetration

Water penetration must not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 547, ASTM E 331.

1.11.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows with insulating glass must not exceed a U-factor of 0.75 Btu/hr-ft^2-F determined according to NFRC 100, and a solar heat gain coefficient (SHGC) of 0.40 Btu/hr-ft^2-F determined according to NFRC 200. Provide window units that comply with the U.S. Department of Energy, Energy Star Window Program for the Southern Climate Zone. 0.40 Btu/hr-ft^2-F determined according to NFRC 100, and a

solar heat gain coefficient (SHGC) of 0.55 Btu/hr-ft^2-F determined according to NFRC 200. Provide window units that comply with the U.S. Department of Energy, Energy Star Window Program for the Central Climate Zone. 0.35 Btu/hr-ft^2-F determined according to NFRC 100. Provide window units that comply with the U.S. Department of Energy, Energy Star Window Program for the Northern Climate Zone.

1.11.5 Condensation Index Rating

The condensation index rating must be 85 as determined using NFRC approved software THERM.

1.11.6 Life Safety Criteria

Provide windows that conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

1.11.7 Sound Attenuation

The window unit must have a minimum STC of 41 with the window glazed with two pieces of 1/4 inch thick laminated glass, 34 with the window glazed with 1/2 inch air space between two pieces of 1/4 inch thick glass when tested in accordance with ASTM E 90 and ASTM E 413.

1.12 QUALIFICATION

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of _____ years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.13 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOWS

Provide prime windows that comply with AAMA 101 and the requirements specified herein. In addition to compliance with AAMA 101, window framing members for each individual lite of glass must not deflect to the extent that deflection perpendicular to the glass lite exceeds L/175 of the glass edge length when subjected to uniform loads at specified design pressures. Provide Structural calculations for deflection to substantiate compliance with deflection requirements. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified. Windows must contain a minimum of 5, 10 percent post-consumer recycled content, or a minimum of 20, 40 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Window materials may contain post-consumer or post-industrial recycled content. Design windows to accommodate hardware, glass, weatherstripping, screens, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum. Provide windows with insulating glass and thermal break necessary to achieve a minimum Condensation Resistance Factor (CRF) of _____ when tested in accordance

with AAMA 1503. Glazed systems (including frames and glass) will be Energy Star labeled products as appropriate to climate zone and as applicable to window type, with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of _____ determined according to NFRC 200 procedures. Glazed systems must have a U-factor maximum of _____ Btu per square foot x hr x degree F in accordance with NFRC 100.

2.1.1 Double Hung Windows (DH)

Type DH-R15, C30, HC40, C, HC, AW-__ (Optional Performance Grade). Test and rate sash balance to conform with AAMA 902.

Windows must be the high-performance classification double-hung type meeting or exceeding AAMA/NWWDA 101/I.S.2 for Type DH-A2-HP and the requirements specified, complete with accessories, fittings, and trim.

Design windows, mullions, hardware, and anchors to withstand the wind loading specified.

2.1.1.1 Window Materials

Window Frames and sash members, mullions, mullion covers, screen frames, and glazing beads must be extruded aluminum shapes fabricated from aluminum conforming to ASTM B 221 and SMA 1004, 6063-T5 aluminum alloy.

Joint-sealing compound must be a gun grade, nonsag, single-component butyl or acrylic sealant conforming to ASTM C 920.

Weatherstripping will be woven wool pile weatherstripping 0.210 inch thick, conforming to AAMA 701, or polypropylene multifilament fiber weatherstripping installed in an integral weatherstripping groove in the sash or frame, and flexible polyvinylchloride weatherstripping installed in the sill member.

2.1.1.2 Subframes

Form subframe members from steel sheets conforming to ASTM A 1011/A 1011M, Grade 36, steel shapes conforming to ASTM A 36/A 36M, or steel tubing conforming to ASTM A 501.

2.1.1.3 Window Construction

Frames, sash, and head members must have a minimum thickness of 0.062 inch. Sills must have a minimum thickness of 0.093 inch, fabricated with an integral stiffening rib, and have weep holes not more than 2 feet on center.

Fabricate horizontal sash members, muntins, and meeting rails of extruded tubular-aluminum sections. Minimum depth of horizontal sash members and meeting rails must be 1-1/16 inches. Provide sash lift that is the full width of the window, extruded as an integral part of the sash.

Frames must have a minimum depth of 3 inches and will be provided with integral stiffening ribs, fins, drip at head, and weatherstripping grooves.

Mechanically join or weld frame and sash members to form rigid flush watertight joints. Joints must be hairline not exceeding 1/64 inch and will be sealed with factory-applied joint compound where required to provide a watertight joint.

Provide expansion between component parts of the window to preclude absorption of thermal stresses in each unit.

2.1.1.4 Hardware for Double-Hung Windows

Locking hardware must be nickel-silver castings conforming to ASTM B 584, Alloy C97600, or AISI Series 300, 18-8 corrosion-resistant steel, or a combination of the two, furnished in contemporary design, smoothly finished, free of defects, and suitable for the intended purpose.

Sash lifts must be continuous extrusions, integral with sash frames. Upper sashes will have matching continuous-extrusion pulls.

Provide double-hung windows with at least one lock and keeper. Fit windows over 3 feet wide with two locks and keepers.

Each sash must operate on two adjustable, replaceable spring or spiral balances meeting the requirements of AAMA 902. Balances must be enclosed in aluminum cases and will be adjustable without removal of the sash from the frame and without the use of special tools.

Furnish meeting rails, 6 feet or higher above the finished floor, with pulldown sockets and pole-operated sash locks. Poles must be tubular or solid steel or aluminum conforming to BHMA A156.16, and will include a cast bronze pole hanger for each pole operator. Provide one pole operator of the required length for each room requiring pole operation. Poles must have a clear lacquer, urethane, or baked-enamel finish.

2.1.1.5 Glazing Requirements

Design windows for field-applied inside glazing, using snap-on, screwless extruded-aluminum beads. Width of the stop bead must be as required for the glass thickness.

Design windows for field-applied outside glazing, using snap-on, screwless, extruded-aluminum beads. Width of the stop bead must be as required for glass thickness.

Design windows for field-applied outside glazing, using glazing clips and glazing compound as specified in Section 08 81 00 GLAZING.

2.1.1.6 Weatherstripping Materials

Install double weatherstripping in jambs, meeting rails, sills, and heads of all windows.

2.1.2 Single-Hung and Double-Hung Windows

Aluminum single-hung (H) and double-hung (H) windows must conform to AAMA 101 H-R15, H-LC25, H-C30, H-HC40, H-AW40 type which operate vertically with the weight of sash offset by a counterbalancing mechanism mounted in window to hold the sash stationary at any open position. Provide windows with a tilt-in sash. Provide single-hung and double-hung windows with locking devices to secure the sash in the closed position. Counterbalancing mechanisms must be easily replaced after installation.

2.1.3 Horizontal Sliding Windows (HS)

Type HS-R15, C30, HC40, C, HC, AW-__ (Optional Performance Grade).

2.1.4 Projected Windows (AP)

Type AP-R15, C30, HC40, C, HC, AW-___ (Optional Performance Grade). Provide projected windows with concealed four bar friction hinges only.

Windows must be high-performance classification projected aluminum sash complete with fins, closures, accessories, fittings, and trim, meeting or exceeding AAMA/NWWDA 101/I.S.2 for Type P-A2-HP and the requirements specified.

Design windows, mullions, hardware, and anchors to withstand the wind loading specified.

Outswinging vents must have not less than a 6-footclearance above the finished grade.

2.1.4.1 Materials

Frames, ventilators, mullions, mullion covers, glazing beads, and fittings must be extruded aluminum shapes fabricated from aluminum conforming to ASTM B 221, 6063-T5 alloy, AAMA/NWWDA 101/I.S.2. Aluminum sheet and plate will be 5005 alloy, temper as required.

Joint sealing compound must be a gun grade, nonsag, single-component butyl or acrylic sealant conforming to ASTM C 920.

Weatherstripping must be extruded flexible polyvinylchloride, weatherstripping grade, conforming to ASTM D 1593, Type I, with a tensile strength of at least 2,200 pounds per square inch (psi) and a tear strength of not less than 275 pounds per inch, closed-cell rubber conforming to ASTM D 1056, Type 2, Grade B Grade 1.

2.1.4.2 Steel Subframes

Subframe members must be the size and weight indicated, formed from steel sheets conforming to ASTM A 1011/A 1011M, steel shapes conforming to ASTM A 36/A 36M, or steel tubing conforming to ASTM A 501. Coat members as specified under "Dissimilar Materials" herein.

2.1.4.3 Construction

Windows must be unequal-leg type, double-contact weathering, with 5/8-inch anchorage and a combined depth of frame and ventilator of not less than 1-3/4 inches. Frames must be not less than 1-1/2 inches deep, and the ventilator will be not less than 1-5/8 inches deep. Minimum web thickness for solid sections must be 1/8 inch, and the minimum web thickness for solid-ventilator hardware rails must be at least 3/16 inch. Tubular sections must have a minimum web thickness of 3/32 inch, and flanges will be not less than 1/8 inch thick.

Provide allowance for expansion between component parts for window assemblies.

Provide integral drip holes or weepholes for exterior in-sill sections at not more than 2 feet on center.

Use tubular sections in horizontal meeting rails longer than 48-7/8 inches.

Corners of window frame assemblies must be coped, double mortised-and-tenoned, and riveted, or mitered and welded.

Miter and weld corners of ventilator frames; mortise and tenon construction is not permitted.

Welds must be continuous across the web member and up the abutting flanges on the unexposed surface. Welds must be dressed smooth and flush on exposed and contact surfaces and will exhibit no discoloration, pitting, or surface defects.

Corner joints must be accurately fitted, flush, watertight hairline joints not exceeding 1/64 inch in width. Apply joint-sealing compound to the unexposed surface of all mortise and tenon joints.

Support ventilators on two aluminum side arms at least 3/16 inch thick by 1 inch wide fitted with nylon friction shoes. Secure arms to vent and frame with 3/8-inch corrosion-resistant steel pivot pins with corrosion-resistant steel bushings or 3/8-inch aluminum pivot pins with nylon bushings. Control ventilator movement by friction shoes sliding in the channel guides of the fixed frame. Assembly will permit removal of the ventilator after installation and will provide an adjustable stop to permit a maximum opening angle of 55 degrees for project-out vents and 30 degrees for project-in vents. An adjustable tension device hold the window open in any position and consist of a fixed- or adjustable-tension corrosion-resistant steel helical spring enclosed in an aluminum or corrosion-resistant steel housing and operating through the friction shoe.

Attach ventilator hardware and balance-arm assembly to ventilator and frame members with corrosion-resistant steel screws threaded into serrated corrosion-resistant steel grommet inserts.

2.1.4.4 Hardware

Operating hardware must be nickel-silver castings conforming to ASTM B 584, Alloy C97600, or AISI Series 18-8 corrosion-resistant steel. Hardware will be a modern design, smoothly finished, free of defects, and suitable for the intended purpose.

Provide cam-action locking handles and strikes for projected-out vents; cam-action locks and provide keepers for projected-in vents. Equip pole-operated projected-in vents with suitable design cam-action locks or spring-catch fasteners.

Strikes and contact surfaces for lock fasteners must be corrosion-resistant steel, nickel silver, or a similar abrasion-resistant metal.

Projected-type ventilators 42 inches and wider and not pole operated must be furnished with two sets of cam-action locking handles.

Provide pole operators for projected-type ventilators located 6 feet or higher above the finished floor. Pole must be tubular steel, solid wood, or aluminum conforming to BHMA A156.16, and will include a cast aluminum or bronze pole hanger, for each pole operator. Provide one pole operator of the required length for each room requiring pole operation. Poles must have a clear lacquer, urethane, or baked-enamel finish.

2.1.4.5 Hardware for Multiple-Sash Operation

Provide hardware and controls for manually operated multiple-sash operation where indicated and complete with brackets, bolts, clips, anchors, and fittings as required for a complete and operable installation.

Operator must be a worm-and-gear torsion rack-and-pinion type. Racks will be die-cut steel bars meshing with a die-cut steel pinion.

Operator must be a screw type assembled in an enclosed housing and containing a threaded phosphor-bronze gear and cast-iron miter gear mounted on antifriction thrust bearings.

The completed installation must operate smoothly without binding and with no noticeable difference in the opening angle between windows in the entire length of the run. Provide windows that open and close simultaneously with not more than a 1-inch difference in opening between the first and the last window at the end of the run and with not more than 5 degrees difference in the angle between connecting arms at the maximum window opening.

2.1.4.6 Glazing Provisions

Design windows for inside glazing, using snap-on, screwless, extruded or roll-formed aluminum, or AISI series-300 corrosion-resistant steel beads. Fixed glazing stops and stop beads must be 3/4 inch high by 1/16 inch thick. Width of the stop bead will be as required for the glass thickness.

Design windows for outside glazing using snap-on, screwless, extruded or roll-formed aluminum, or AISI series-300 corrosion-resistant steel beads. Fixed glazing stops and stop beads must be 3/4 inch high by 1/16 inch thick. Width of the stop bead will be as required for the glass thickness.

Design windows for outside glazing, using glazing clips and glazing compound as specified in Section 08 81 00 GLAZING.

2.1.4.7 Weatherstripping

Windows must have double continuous extruded weatherstripping set in integrally formed pockets in the sash.

Windows must have single continuous extruded weatherstripping set in integrally formed pockets in the sash.

2.1.4.8 Aluminum Sills

Sills will be the profiles and dimensions indicated, the same alloy and finish as windows, at least 1/8 inch thick, and furnished the full width of the window opening.

Securely anchor sills in place with concealed anchors not more than 18 inches on center.

2.1.5 Top-Hinged Windows (TH)

Type TH-C30, HC40, C, HC, AW-___ (Optional Performance Grade). Top-hinged windows must be inswinging, outswinging.

2.1.6 Vertically Pivoted Windows (VP)

Type VP-R15, C30, HC40 (Optional Performance Grade). Provide window with remotely operated venetian blind mounted between an access sash and the main sash.

2.1.7 Fixed Windows (F)

Type F-R15, C30, HC40, C, HC, AW-___ (Optional Performance Grade).

2.1.8 Forced Entry Resistant Windows

In addition to meeting the requirements of AAMA 101, windows designated for resistance to forced entry must conform to the requirements of AAMA 1302.5.

2.1.9 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

2.1.10 Calking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

2.1.11 Weatherstripping

AAMA 101.

2.2 FABRICATION

Fabrication of window units must comply with AAMA 101.

2.2.1 Provisions for Glazing

Design windows and rabbets suitable for glass thickness shown or specified. For minimum antiterrorism windows, adher glazing to its supporting frame using structural silicone sealant or adhesive glazing tape. The width of the structural silicone sealant bead must be at least equal to, but not larger than two times the thickness designation of the glass to which it adheres. The width of the adhesive glazing tape will be at least equal to two times, but not more than four times the thickness designation of the glass to which it adheres. Design sash for inside, outside, single, double glazing and for securing glass with metal beads, glazing clips, glazing channels, or glazing compound.

2.2.2 Weatherstripping

Provide for ventilating sections of all windows to ensure a weather-tight seal meeting the infiltration requirements specified in AAMA 101. Provide easily replaceable factory-applied weatherstripping. Use molded vinyl, molded or molded-expanded neoprene or molded or expanded Ethylene Propylene Diene Terpolymer (EPDM) compression-type weatherstripping for compression contact surfaces. Use treated woven pile or wool, or polypropylene or nylon pile bonded to nylon fabric and metal or plastic backing strip weatherstripping for sliding surfaces. Do no use neoprene or polyvinylchloride weatherstripping where they will be exposed to direct sunlight.

2.2.3 Fasteners

Fabricated from 100 percent re-melted steel. Use fasteners as standard with the window manufacturer for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick.

2.2.4 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials, GS-36, SCAQMD Rule 1168, and as specified in Section 07 92 00 JOINT SEALANTS.

2.2.5 Drips and Weep Holes

Provide continuous drips over heads of top ventilators. Where fixed windows adjoin ventilators, drips must be continuous across tops of fixed windows. Provide drips and weep holes as required to return water to the outside.

2.2.6 Combination Windows

Windows used in combination must be the same class and grade and will be factory assembled. Where factory assembly of individual windows into larger units is limited by transportation considerations, prefabricate, match mark, transport, and field assemble.

2.2.7 Mullions and Transom Bars

Provide mullions between multiple window units which meet the design pressure of 15, 30, 40 psf. Provide mullions with a thermal break. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form a weathertight joint. Where window cleaner anchors are required, reinforce mullions and anchor to adjoining construction so as to provide safe and adequate support. Provide mullion covers on the interior and exterior to completely close exposed joints and recesses between window units and to present a neat appearance. Provide special covers over structural support at mullions as indicated.

2.2.8 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation. Furnish extruded aluminum subframe receptors and subsill with each window unit.

2.2.8.1 Hardware

AAMA 101. The item, type, and functional characteristics must be the manufacturer's standard for the particular window type. Provide hardware of suitable design and of sufficient strength to perform the function for which it is used. Equip all operating ventilators with a lock or latching device which can be secured from the inside.

2.2.8.2 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners

must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 6 inches from each end and at midpoint.

2.2.9 Finishes

Exposed aluminum surfaces must be factory finished with an anodic coating or organic coating. Color must be as indicated. All windows for each building will have the same finish.

2.2.9.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45 and AAMA 611. Finish must be:

a. Architectural Class II (0.4 mil to 0.7 mil), designation AA-M10-C22-A31, clear (natural), A32, integral color, A34, electrolytically deposited color anodized.

b. Architectural Class I (0.7 mil or thicker), designation AA-M10-C22-A41, clear (natural), A42, integral color, A44, electrolytically deposited color anodized.

2.2.10 Screens

AAMA 101. Provide one insect screen for each operable exterior sash or ventilator. Design screens to be rewirable, easily removable from inside the building, and to permit easy access to operating hardware.

2.3 SPECIAL OPERATORS

For windows having operating hardware or locking or latching devices located more than 6 feet above the floor, provide suitably designed operators or locking or latching devices necessary for convenient and proper window operation.

2.3.1 Pole Operators

Poles must be of proper length to permit window operation from 5 feet above the floor. Provide one pole operator for each room, and one pole hanger for each pole. Locate hangers where directed.

2.3.2 Extension Crank Operators

Provide removable handles for crank-operated rotary-type operators located more than 6 feet above the floor. Provide one removable handle for each room.

2.4 THERMAL-BARRIER WINDOWS

Provide thermal-barrier windows, complete with accessories and fittings, where indicated.

Specify material and construction except as follows:

a. Aluminum alloy must be 6063-T6.

b. Frame construction, including operable sash, must be factory-assembled and factory-sealed inner and outer aluminum

completely separated from metal-to-metal contact. Join assembly by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner frame. Metal fasteners, straps, or anchors will not bridge the connection between the inner and outer frame.

c. Operating hardware for each sash must consist of spring-loaded nylon cushion blocks and pin locks designed to lock in predetermined locations.

d. Sash must be completely separated from metal-to-metal contact by means of woven-pile weatherstripping, plastic, or elastomeric separation members.

e. Operating and storm sash will be factory-glazed with the type of glass indicated and of the quality specified in Section 08 81 00 GLAZING.

2.5 MULLIONS

Provide mullions between multiple-window units where indicated.

Mullions and mullion covers must be the profile indicated, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion will include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly must include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover must be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members must be steel or aluminum shapes provided by the window manufacturer to meet the specified design loading.

2.6 SCREENS

Provide removable, rewireable, interchangeable aluminum insect screens for window openings as indicated and complete with installation hardware and fasteners.

Frames must be extruded tubular aluminum, the same alloy and finish coating as specified for windows, at least 1/16 inch web thickness, at least 7/16 inch deep by 1-1/2 inches high. Corners must be mitered, welded, and dressed smooth and flush. Frames will include integral extruded grooves to receive and retain screen splines. Splines must be miter cut and provide neat close-fitting joints no wider than 1/32 inch.

Fabric must be 18 by 16 mesh by 0.011 inch diameter, Alclad aluminum alloy wire screen conforming to ASTM E 2016. Screens will be held taut and smooth in frames by removable vinyl splines.

Projected windows must receive screens over ventilators where indicated. Provide horizontal sliding or hinged wicket screens where access to operating hardware is required. Frame wicket screens with horizontal and vertical aluminum tubular or solid frame members and equip with friction catches.

Double-hung windows must receive single vertical sliding screens with integral extruded hand grips, corrosion-resistant steel friction springs, and concealed locking bolts, mounted in integral guides in the window frame.

Double-hung windows must receive double vertical sliding screens with integral extruded hand grips, corrosion-resistant steel friction springs, and concealed locking bolts, mounted in integral guides in the window frame.

2.7 FINISH

Aluminum windows, mullions, glazing beads, trim, and accessory fittings must be cleaned, and receive an Architectural Class II natural anodic coating (designation AA-M-12C22A31) in accordance with AA DAF-45. Anodic coating will be not less than 0.4 mil.

Aluminum window, mullions, glazing beadings, trim, and accessory fittings must be thoroughly cleaned and will receive an Architectural Class I natural anodic coating (designation AA-M-12C22A41) in accordance with AA DAF-45. Anodic-coating thickness must be not less than 0.7 mil.

Test the thickness of the anodic coating in accordance with ASTM B 244.

Anodic coating must be continuous and, without being lacquered, will be capable of withstanding 500 hours of salt-spray exposure for Class A anodic coatings and 250 hours of salt-spray exposure for Class B anodic coatings when tested in accordance with ASTM B 117.

2.7.1 Anodized Aluminum Finish

Finish exposed surfaces of aluminum windows with anodic coating conforming to AA DAF-45: Architectural Class II, AA-M10-C22-A31, clear anodic coating, 0.4 to 0.8 mil thick, 204-R1 Natural Color, Architectural Class I, AA-M10-C22-A41, clear anodic coating, 0.8 mil or thicker, 215-R1 Natural Color, Architectural Class I, AA-M10-C22-A44, color anodic coating, 0.8 mil or thicker. Finish must be free of scratches and other blemishes.

2.7.2 Baked-Acrylic Resin-Based Coating

Finish exposed surfaces of aluminum windows with acrylic resin-based coating conforming to AAMA 2603, total dry thickness of 1.2 mils. Finish must be free of scratches and other blemishes.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a

manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surfacefrom dissimilar materials as recommended in the Appendix to AAMA 101. Do not coat surfaces in contact with sealants after installation with any type of protective material.

3.1.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in masonry walls must have head and jamb members designed to recess into masonry wall not less than 7/16 inch.

3.1.4 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary. Adjust double hung windows to operate with maximum applied force of 25 pounds in either direction, not including breakaway friction force. Verify that products are properly installed, connected, and adjusted.

3.2 ADJUSTMENT AFTER INSTALLATION

After the sash is erected and glazed, lubricate and adjust ventilators for smooth weathertight operation. Wax or lubricate guides and adjust balances for the proper tension.

Weatherstripping must make weathertight contact around the entire weatherstripped area when ventilators are closed and locked. Weatherstripping must not cause the sash to bind or prevent closing and locking the ventilator.

3.2.1 Hardware Adjustments

Make final operating adjustments after glazing work is complete. Operating sash or ventilators must operate smoothly and be weathertight when in locked position.

3.2.2 Cleaning

Clean aluminum window finish and glass on exterior and interior sides in accordance with window manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring window finish and glass surfaces.

3.3 DISSIMILAR MATERIALS

Aluminum must be kept from direct contact with steel or other dissimilar materials by painting, nonabsorptive tape, gasket, or other approved system as recommended by the manufacturer and as specified.

Give aluminum surfaces in contact with steel one coat of zinc-chromate

primer applied to a dry-film thickness of not less than 1.5 mils, or one coat of a suitable nonhardening joint compound capable of excluding moisture from the joint during prolonged service.

Give steel surfaces in contact with aluminum one coat of zinc-chromate paint applied to a dry-coat thickness of 1.5 mils, and two or more coats of aluminum paint conforming to SSPC Paint 101, aluminum alkyd, Type II, applied to a dry-film thickness of 1.5 mils for each coat and a total dry-film thickness of 3.0 mils.

Corrosion-resistant, aluminized, or hot-dip galvanized steel placed in contact with aluminum need not be painted.

Give aluminum surfaces placed in contact with wood, concrete, or masonry construction one coat of bituminous paint conforming to SSPC Paint 12, applied to a thickness of at least 1/16 inch.

3.4 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

3.5 WASTE MANAGEMENT

Separate corrugated cardboard and protective materials in accordance with the Waste Management Plan and place in designated areas for reuse or recycling. Place materials defined as hazardous or toxic waste in designated containers. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperature. Place used sealant tubes and containers in areas designated for hazardous materials.

-- End of Section --

SECTION 08 56 53

BLAST RESISTANT TEMPERED GLASS WINDOWS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(2005) Standard Specification for Windows, Doors, and Unit Skylights
AAMA 2603	(2002) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	(2005) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2004) Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1048	(2004) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2004) Glazing Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Window units

Submit drawings indicating elevations of windows, full-size sections, thickness of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, complete details of setting methods and materials for each type of glazing material, details of hardware, mullion details, method and materials for weatherstripping, support conditions for the glass, material and method of attaching subframes, stools, casings, sills, trim, window cleaner anchors, installation details, and other related items.

SD-03 Product Data

Window units

Hardware

Setting materials

Weatherstripping

Submit window frame data for each type and finish.

SD-04 Samples

Window units

Submit when factory-finished color coating is provided.

SD-08 Manufacturer's Instructions

Glass

Submit glass manufacturer's instructions for setting and sealing materials and for installation of each type of glazing material specified.

SD-10 Operation and Maintenance Data

Window units, Data Package 1

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 QUALITY ASSURANCE

1.3.1 Label

Each prime window unit shall bear the AAMA Label warranting that the product complies with AAMA 101. Certificates of Compliance attesting that the prime window units meet the requirements of AAMA 101 will be acceptable

in lieu of product labeling.

1.3.2 Glass and Glazing

Provide materials that are certified to meet ANSI Z97.1 by an independent testing laboratory.

1.3.3 Independent Testing

Testing shall be performed by an independent testing laboratory (certified by the Contracting Officer) and test report shall be signed by a registered professional engineer and shall include results from tests in the calculations.

1.4 DELIVERY, STORAGE, AND HANDLING

a. Deliver products to the site in unopened containers, labeled plainly with manufacturers' name and brands. Deliver window assemblies in an undamaged condition. Exercise care in handling and hoisting windows during transportation and at the job site. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows.

b. Finished surfaces shall be protected during shipping and handling using the manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which sealants, caulking, or glazing compounds must adhere.

1.5 ENVIRONMENTAL CONDITIONS

Do not start glazing work until the outdoor temperature is above40 degrees F and rising unless approved provisions are made to warm the glass and rabbet surfaces. Provide sufficient ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work if moisture collects on window assemblies or during rainy weather.

PART 2 PRODUCTS

2.1 WINDOW UNITS

Primed window frames shall conform to AAMA 101 and the requirements specified herein. Provide windows of types, grades, performance classes, combinations, and sizes indicated or specified. Provide windows to accommodate hardware, glass, weatherstripping and accessories. Each window shall be a complete factory-assembled unit with glass factory or field installed.

2.2 WEATHERSTRIPPING

Weatherstripping shall conform to AAMA 101.

2.3 GLASS

Use ASTM C 1048 and ANSI Z97.1 Grade B (tempered), Style I (uncoated), Type 2, Class 1 (transparent), 2 (heat absorbing).

2.4 SETTING MATERIALS

Provide types required for the applicable setting method specified in the GANA Glazing Manual, unless specified otherwise herein. Do not use metal sash putty, non-skinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray, black or neutral color.

2.4.1 Elastomeric Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Use for channel or stop glazing and metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes. Color of sealant shall be as selected, gray, black, white.

2.4.2 Sealing Tapes, Beads or Gaskets

Gaskets or beads shall be at least 3/8 inch wide with a Shore "A" durometer hardness of 50 and conform to ASTM C 509.

2.4.3 Setting Blocks and Edge Blocks

Use neoprene of 70 to 90 Shore "A" durometer hardness, chemically compatible with sealants used, and of sizes recommended by the glass manufacturer.

2.4.4 Accessories

Use accessories as required to provide a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

2.5 WINDOW ASSEMBLIES

Window units shall conform to AAMA 101.

2.5.1 Provisions for Glazing

Provide windows and rabbets suitable for specified glass thickness. Minimum edge clearance shall be _____. Nominal bite shall be _____. Minimum face clearance shall be _____. Provide sash for glazing and for securing glass with metal beads, glazing clips, glazing channels and glazing compound.

2.5.2 Sealant, Gaskets, and Beads

Sealant, gaskets, and beads shall be continuous around the perimeter of the glass.

2.5.3 Weatherstripping

Provide for ventilating sections of windows to ensure a weathertight seal meeting the infiltration requirements specified in AAMA 101. Provide factory-applied weatherstripping that can be replaced by field repair mechanics. Use molded vinyl, molded or molded-expanded neoprene for weatherstripping for compression contact surfaces. Do not use neoprene or polyvinyl chloride weatherstripping where it will be exposed to direct sunlight.

2.5.4 Fasteners

Provide flathead, cross-recessed type, exposed head screws and bolts with standard threads for use on windows, trim, and accessories. Screw heads shall finish flush with adjoining surfaces. Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick.

2.5.5 Drips and Weep Holes

Provide continuous drips over heads of top ventilators. Where fixed windows adjoin ventilators, drips shall be continuous across tops of fixed windows. Provide drips and weep holes as required to return water to the outside.

2.5.6 Combination Windows

Windows used in combination shall be the same grade and performance class and shall be factory assembled. Where factory assembly of individual windows into larger units is limited by transportation considerations, prefabricate, match mark, transport, and field assemble.

2.5.7 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation.

2.5.8 Hardware

The item, type, and functional characteristics shall be the manufacturer's standard for the particular window type and shall conform to AAMA 101. Provide hardware that functions after the window assembly has withstood the application of the design blast pressure causing the development of a static design resistance, ru, uniformally applied over both glazing and frame as defined in paragraph entitled "Certificates of Compliance" of this section. Equip operating ventilators with a lock or latching device which can be secured from the inside.

2.5.9 Anchors

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners shall be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 6 inches from each end and at midpoint.

2.5.10 Finishes

Exposed aluminum surfaces shall be factory finished with an anodic coating or organic coating. Color shall be as indicated. Windows for each building shall have the same finish.

2.5.10.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45. Finish shall be _____.

2.5.10.2 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a baked enamel finish in accordance with AAMA 2603 with total dry film thickness not less than 0.8 mil, high-performance finish in accordance with AAMA 2604 with total dry film thickness of not less than 1.2 mils.

2.6 SOURCE QUALITY CONTROL

2.6.1 Window Assembly Structural Test

2.6.1.1 Test Sample Number

At least two sample window assemblies for each type of window provided shall be tested, under an increasing uniform static load. Number of samples, beyond two, is left up to the vendor. However, it is noted that the acceptance criteria encourages a larger number of test samples.

2.6.1.2 Test Procedure

Test windows (glass panes and support frame) shall be identical in type, size, sealant, gasket or bead and construction to those furnished by the window manufacturer. The frame assembly in the test setup shall be secured by boundary conditions that simulate the adjoining walls of the structure for intended installation. The simulation securing boundary conditions shall be verified and attested by an attending Professional Engineer. Using either a vacuum or a liquid-filled bladder, an increasing uniform load shall be applied to the entire window assembly (glass and frame) until failure occurs in either the glass or frame. Failure shall be defined as either breaking of glass or loss of frame resistance. The failure load, rf, shall be recorded to three significant figures. The load should be applied at a rate of 0.5 ru per minute where ru is the static design resistance:

Glass Size	Static Design Resistance
_____x_____ inch	_____ psi

2.6.1.3 Acceptance Criteria

The static load capacity (rs) of a glass pane for the specified acceptance test procedure is:

$$rs = 0.876\ ru \quad (1)$$

The window assembly (frame and glass) is considered acceptable when the arithmetic mean of all the samples tested, r- such that:

$$r- \Rightarrow rs + sA \quad (2)$$

where: rs = static load capacity of the glass pane for certification testing
s = sample standard deviation
A = acceptance coefficient (Table 1)

a. Arithmetic mean/standard deviation: For n test samples, r- is defined as:

r- = sum from i = 1 thru n for rfi divided by n (3)

where rfi is the recorded failure load of the ith test sample.

The sample standard deviation, s, is defined as:

s = the square root of the quantity of the sum from i = 1 thru n for (rfi - r-2) divided by (n - 1) (4)

The minimum value of the sample standard deviation, s, permitted to be employed in Equation (2) is:

s = 0.145 rs (5)

This assures a sample standard deviation no better than observed for the general population of tempered glass.

b. Additional sampled determination: The following equation can be used by tester to determine if additional test samples are justified. If:

r- =< rs + sB (6)

then with 90% confidence, the design will not prove to be adequate with additional tests. Obtain rejection coefficient, B, from Table 1.

Table 1. Statistical Acceptance and Rejection Coefficients

Number of Window Assemblies n	Acceptance Coefficient A	Rejection Coefficient B
2	4.14	.546
3	3.05	.871
4	2.78	1.14
5	2.65	1.27
6	2.56	1.36
7	2.50	1.42
8	2.46	1.48
9	2.42	1.49
10	2.39	1.52
11	2.37	1.54
12	2.35	1.57
13	2.33	1.58
14	2.32	1.60
15	2.31	1.61
16	2.30	1.62
17	2.28	1.64
18	2.27	1.65
19	2.27	1.65
20	2.26	1.66
21	2.25	1.67
22	2.24	1.68
23	2.24	1.68
24	2.23	1.69
25	2.22	1.70
30	2.19	1.72
40	2.17	1.75
50	2.14	1.77

Table 1. Statistical Acceptance and Rejection Coefficients

Number of Window Assemblies n	Acceptance Coefficient A	Rejection Coefficient B

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Set windows at proper elevation, location, and reveal. Brace properly to prevent distortion and misalignment. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install windows in a manner that will prevent entrance of water. Fasten hardware to windows.

3.1.2 Glass Setting

Items to be glazed shall be either shop or field glazed using glass of the quality and thickness specified or indicated. Preparation and glazing, unless otherwise approved, shall conform to applicable recommendations in the GANA Glazing Manual. Windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops furnished with items to be glazed, to secure glass in place.

3.1.3 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to, masonry, wood, or dissimilar metals, except stainless steel or zinc, the aluminum surface shall be protected from dissimilar materials as recommended in the Appendix to AAMA 101. Do not coat surfaces on which sealants are to adhere.

3.1.4 Anchors and Fastenings

Make provision for securing units to each other and to adjoining construction.

3.1.5 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as recommended by the manufacturer.

3.2 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weatherstripping, and to prevent interference with the operation of hardware. Remove stained, discolored, or abraded windows that cannot be restored to their

original condition, and replace with new windows.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(2006) Butts and Hinges
BHMA A156.12	(2005) Interconnected Locks & Latches
BHMA A156.13	(2005) Mortise Locks & Latches, Series 1000
BHMA A156.15	(2006) Closer Holder Release Devices
BHMA A156.16	(2002) Auxiliary Hardware
BHMA A156.17	(2004) Self Closing Hinges & Pivots
BHMA A156.18	(2006) Materials and Finishes
BHMA A156.2	(2003) Bored and Preassembled Locks and Latches
BHMA A156.21	(2006) Thresholds
BHMA A156.22	(2005) Door Gasketing and Edge Seal Systems
BHMA A156.3	(2001) Exit Devices
BHMA A156.4	(2000) Door Controls - Closers
BHMA A156.5	(2001) Auxiliary Locks & Associated Products
BHMA A156.6	(2005) Architectural Door Trim
BHMA A156.7	(2003) Template Hinge Dimensions
BHMA A156.8	(2005) Door Controls - Overhead Stops and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2005; Errata 2006; TIA 2006; TIA 2006) Life Safety Code, 2006 Edition
NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDOI)

SDI/DOOR A250.8	(2003) Recommended Specification for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 14C	(2006) Swinging Hardware for Standard Tin-Clad Fire Doors Mounted Singly and in Pairs
UL Bld Mat Dir	(2007) Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Hardware schedule

Keying system

SD-03 Product Data

Hardware items

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key Bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hard-	Reference Publi- cation	Mfr. Name and	Key Con-	UL Mark (If fire rated	BHMA Finish

ware Item	Quan-tity	Size	Type No.	Finish	Catalog No.	trol Symbols	and listed)	Designa-tion

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Contact Contracting Officer for keying information.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, pivots, and closers of one lock, hinge, pivot, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal or to prefinished doors manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements indicated, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Conform to UL 14C for swinging hardware for the tin-clad fire doors. Provide the label of Underwriters Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

BHMA A156.1, 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct

loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.2 Pivots

BHMA A156.4.

2.3.3 Spring Hinges

BHMA A156.17.

2.3.4 Locks and Latches

2.3.4.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide factory-installed lead lining in locks for lead-shielded doors. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.4.2 Bored Locks and Latches

BHMA A156.2, Series 4000, Grade 1. Provide factory-installed lead lining in locks for lead-shielded doors.

2.3.4.3 Residential Bored Locks and Latches

BHMA A156.2, Series 4000, Grade 2. Install locks for exterior doors with threaded roses or concealed machine screws.

2.3.4.4 Interconnected Locks and Latches

BHMA A156.12. Provide F96 or F97, unless otherwise specified.

2.3.4.5 Auxiliary Locks

BHMA A156.5, Grade 1.

2.3.4.6 Combination Locks

Pharmacy door locks shall be keyed separately from building master key system. Heavy-duty, mechanical combination lockset with five pushbuttons, standard-sized knobs, 3/4 inch deadlocking latch, 2-3/4 inch backset. Operate the locks by pressing two or more of the buttons in unison or individually in the proper sequence. Inside knob will operate the latch. Provide a keyed cylinder on the interior to permit setting the combination. Provide a keyed removable-core cylinder on the exterior to permit bypassing the combination. Provide a thumb turn on the interior to activate passage set function, so that outside knob operates latch without using the combination.

2.3.5 Exit Devices

BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and

vertical rod devices. Provide touch bars in lieu of conventional crossbars and arms. Provide escutcheons, not less than 7 by 2-1/4 inch.

2.3.6 Exit Locks With Alarm

BHMA A156.5, Type E0431 (with full-width horizontal actuating bar) for single doors; Type E0431 (with actuating bar) or E0471 (with actuating bar and top and bottom bolts, both leaves active) for pairs of doors, unless otherwise specified. Provide terminals for connection to remote indicating panel. Provide outside control key.

2.3.7 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with seven pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets have interchangeable cores which are removable by special control keys. Engrave on or stamp into the metal of each interchangeable core with a key control symbol in a concealed place on the core.

Provide cylinders for new locks, including locks provided under other sections of this specification. Provide fully compatible cylinders with products of the Best Lock Corporation with interchangeable cores which are removable by a special control key. Factory set the cores with seven pin tumblers, contact Contracting Officer for keying requirements. Submit a core code sheet with the cores. Provide master keyed cores in one system for this project. Provide construction interchangeable cores.

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with seven pin tumblers. Provide cylinders with interchangeable and fully compatible with products from Best Lock Corp., Arrow Lock Corp., or Falcon Lock which are removable by special control keys. Engrave on or stamp into the metal of each interchangeable core with a key control symbol in a concealed place on the core.

For medical projects, pharmacy door locks shall be keyed separately from building master key system.

2.3.8 Keying System

Provide a great, grand, master keying system, an extension of the existing keying system. Existing locks were manufactured by _____ and do not have interchangeable cores. Provide a construction master keying system, construction interchangeable cores. Provide key cabinet as specified.

Provide sub-master keying system for the, each building, and keyed to the existing Best removable-core master and grand master keying systems. Key equipment spaces and mechanical rooms separately from the building systems, and keyed alike to the existing Best master and grand master systems for these doors.

The Contractor will provide permanent cylinders with cores and keys for mortise locksets, auxiliary locks, and exit devices. Furnish cylinders as manufactured by Best Lock Corp., Arrow Lock Corp., or Falcon Lock. Notify the Contracting Officer 90 days prior to the required delivery of the cylinders. Provide temporary cores and keys for the Contractor's use

during construction, and for testing the locksets.

2.3.9 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.9.1 Knobs and Roses

Conform to the minimum test requirements of BHMA A156.2 and BHMA A156.13 for knobs, roses, and escutcheons. For unreinforced knobs, roses, and escutcheons, provide 0.050 inch thickness. For reinforced knobs, roses, and escutcheons, provide outer shell of 0.035 inch thickness, and combined thickness of 0.070 inch, except for knob shanks, which are 0.060 inch thick.

2.3.9.2 Lever Handles

Provide lever handles in lieu of knobs where indicated in paragraph entitled "Hardware Schedule". Conform to the minimum requirements of BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.3.9.3 Texture

Provide knurled or abrasive coated knobs or lever handles where specified in paragraph entitled "Hardware Schedule", for doors which are accessible to blind persons and which lead to dangerous areas.

2.3.10 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master, and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish four additional keys for each sleeping room. Furnish great grand master keys, construction master keys, and control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

Furnish seven change keys for each interchangeable core, furnish two control keys, six maters keys, and six construction master keys. Furnish a quantity of key blanks equal to 20 percent of the total number of change keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room numbers on keys.

2.3.11 Door Bolts

BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25.

2.3.12 Closers

BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, pivots, cement cases, and other features necessary for the particular application. Size closers in accordance with manufacturer's

recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.12.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.13 Overhead Holders

BHMA A156.8.

2.3.14 Closer Holder-Release Devices

BHMA A156.15.

2.3.15 Door Protection Plates

BHMA A156.6.

2.3.15.1 Sizes of Armor, Mop, and Kick Plates

2 inch less than door width for single doors; one inch less than door width for pairs of doors. Provide 8, 10 inch kick plates for flush doors and one inch less than height of bottom rail for panel doors. Provide a minimum 36, 48 inch armor plates for flush doors and completely cover lower panels of panel doors, except 16 inch high armor plates on fire doors. Provide 4, 6 inch mop plates.

2.3.16 Edge Guards

BHMA A156.6, stainless steel, of same height as armor plates. Apply to hinge stile, lock stile, meeting stiles.

2.3.17 Door Stops and Silencers

BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.18 Thresholds

BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.19 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors not to exceed 0.5, 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283. Provide weather stripping with one of the following:

2.3.19.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural), bronze anodized aluminum.

2.3.19.2 Interlocking Type

Zinc or bronze not less than 0.018 inch thick.

2.3.19.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.008 inch thick.

2.3.20 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint, prime coat, finish for surface door closers, and except BHMA 652 finish (satin chromium plated), BHMA 600 finish (primed for painting) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph entitled "Hardware Sets". Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

2.6 KEY CABINET AND CONTROL SYSTEM

BHMA A156.5, Type E8331 (25 hooks), E8341 (125 hooks), E8351 (150 hooks), E8311 (600 hooks), E8321 (700 hooks). Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door one inch on centerand to heads and jambs at 4 inch on center

3.1.1.3 Spring Tension Type Weather Stripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze, stainless steel nails with stainless steel. Space nails not more than 1-1/2 inch on center.

3.1.2 Lightproofing and Soundproofing Installation

Install as specified for stop-applied weather stripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors, and UL 14C for swinging tin-clad fire doors.

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed, indicated. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

Provide hardware for aluminum doors under this section. Deliver Hardware templates and hardware, except field-applied hardware to the aluminum door and frame manufacturer for use in fabricating the doors and frames.

-- End of Section --

SECTION 08 81 00

GLAZING

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2004) Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2005; Supp 1) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036	(2006) Standard Specification for Flat Glass
ASTM C 1048	(2004) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 1172	(2003) Standard Specification for Laminated Architectural Flat Glass
ASTM C 1184	(2005) Standard Specification for Structural Silicone Sealants
ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 669	(2000) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 864	(2005) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 395	(2003) Standard Test Methods for Rubber Property - Compression Set
ASTM E 119	(2007a) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E 1300	(2007) Determining Load Resistance of Glass in Buildings
ASTM E 2010	(2001) Positive Pressure Fire Tests of Window Assemblies
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 413	(2004) Rating Sound Insulation
ASTM E 773	(2001) Accelerated Weathering of Sealed Insulating Glass Units
ASTM E 774	(1997) Classification of the Durability of Sealed Insulating Glass Units
ASTM E 90	(2004) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2004) Glazing Manual
GANA Sealant Manual	(1990) Sealant Manual
GANA Standards Manual	(2001) Tempering Division's Engineering Standards Manual

THE INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-3001	(1990) Guidelines for Sloped Glazing
IGMA TM-3000	(1997) Glazing Guidelines for Sealed Insulating Glass Units
IGMA TR-1200	(1983) Commercial Insulating Glass Dimensional Tolerances

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2004) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2004) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	(2007) Standard Methods of Fire Tests of Door Assemblies
NFPA 257	(2006) Fire Test for Window and Glass Block Assemblies

NFPA 80	(2007) Standard for Fire Doors and Other Opening Protectives

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-378	(Basic; Notice 1) Putty Linseed Oil Type, (for Wood-Sash-Glazing

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201	Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 752	(2005; Rev thru Dec 2006) Bullet-Resisting Equipment
UL MEAPD	(2003) Mechanical Equipment and Associated Products Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

Control Tower Insulating Glass

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-03 Product Data

Insulating Glass

Documentation for Energy Star qualifications.

Plastic Glazing

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

SD-04 Samples

Insulating Glass

Plastic Sheet

Glazing Compound

Glazing Tape

Sealant

Two 8 x 10 inch samples of each of the following: tinted glass, patterned glass, heat-absorbing glass, and insulating glass units.

Three samples of each indicated material. Samples of plastic sheets shall be minimum 5 by 7 inches.

SD-07 Certificates

Insulating Glass

Plastic Glazing

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

Control Tower Insulating Glass

Glazing Accessories

Certificates from the manufacturer attesting that the units meet the luminous and solar radiant transmission requirements for heat absorbing glass.

SD-08 Manufacturer's Instructions

Setting and sealing materials

Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified. Include cleaning instructions for plastic sheets.

SD-11 Closeout Submittals

Local/Regional Materials; LEED

LEED (tm) documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Glazing materials may be locally available.

1.6.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

1.7 WARRANTY

1.7.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction

to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government. For control tower units, the warranty period shall be 10 years; warranty shall be signed by the manufacturer.

1.7.2 Warranty for Polycarbonate Sheet

For a 5-year period following acceptance of the work:

a. Warranty Type I, Class A (UV stabilized) sheets against breakage;

b. Warranty Type III (coated, mar-resistant) sheets against breakage and against coating delamination;

c. Warranty Type IV (coated sheet) against breakage and against yellowing;

d. Warranty extruded polycarbonate profile sheet against breakage.

For a 10-year period following acceptance of the work, warranty Type IV against yellowing and loss of light transmission.

PART 2 PRODUCTS

2.1 GLASS

ASTM C 1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

For interior glazing (i.e., pass and observation windows), 1/4 inch thick glass should be used.

Type I, Class 1 (clear), Quality q4 (A), q5 (B). Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not over 45 square feet.

2.1.2 Wired Glass

Glass for fire-rated windows shall be UL listed and shall be rated for 45, 20 minutes when tested in acccordance with ASTM E 2010. Wired glass shall be Type II flat type, Class 1 - translucent, 2 - tinted, heat-absorbing, 3 - tinted, light-reducing, Quality q7 - decorative, q8 - glazing, Form 1 - wired and polished both sides, 2 - patterned and wired, ___ percent light transmittance, _____ percent shading coefficient, conforming to ASTM C 1036. Wire mesh shall be polished stainless steel Mesh 1 - diamond, 2 - square, 3 - parallel. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for 20, 45 minutes when tested in accordance with NFPA 257. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252.

2.1.3 Laminated Glass

ASTM C 1172, Kind LA fabricated from two nominal 1/8 inch pieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C 1036. Flat glass shall be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral interlayer. The total thickness shall be nominally 1/4 inch. Fabricated from two pieces of Type I, Class 1, Quality q3 glass laminated together with a clear 0.015 inch thick polyvinyl butyral interlayer or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C 1172. Color shall be clear, gray, bronze . The total thickness shall be nominally _____ inch. Provide _____.

2.1.4 Bullet-Resisting Glass

Fabricated from Type I, Class 1, Quality q3 glass with polyvinyl butyral plastic interlayers between the layers of glass and listed by UL MEAPD as bullet resisting, with a power rating of Medium--Small Arms, High--Small Arms, Super--Small Arms, High--Rifle in accordance with UL 752. Provide where indicated.

2.1.5 Mirrors

2.1.5.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, 2-tinted, Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Glass color shall be clear, bronze, gray, as shown in Section 09 06 90 COLOR SCHEDULE. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint , and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.1.6 Tempered Glass

ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent), 2 (tinted heat absorbing), Quality q3, _____ inch thick, _____ percent light transmittance, _____ percent shading coefficient conforming to ASTM C 1048 and GANA Standards Manual. Color shall be clear, bronze, gray. Providewherever safety glazing material is indicated or specified.

2.1.7 Fire/Safety Rated Glass

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a 20, 45, 60 minute rating when tested in accordance with ASTM E 119. Glass shall be permanently labeled with appropriate markings.

2.1.8 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, _____ percent light transmittance, _____ percent shading coefficient, conforming to ASTM C 1036. Color shall be gray, bronze, as shown in Section 09 06 90 COLOR SCHEDULE.

2.2 INSULATING GLASS UNITS

Two panes of glass separated by a dehydrated 1/2 inch airspace, filled with argon, 3/8 inch airspace, filled with krypton, gas, 0.63, 1.26 inches of aerogel and hermetically sealed. Glazed systems (including frames) shall be Energy Star labeled products as appropriate to climate zone and as applicable to window type, with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of _____ determined according to NFRC 200 procedures. Glazed panels and curtain walls shall have a U-factor maximum of _____ Btu per square foot x hr x degree F in accordance with NFRC 100. Glazing shall meet or exceed a luminous efficacy of 1.0. Glazed panels shall be rated for not less than 26, 30, 35 Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413. Dimensional tolerances shall be as specified in IGMA TR-1200. The units shall meet CBA Grade requirement when tested in accordance with ASTM E 773 and ASTM E 774, Class A. Spacer shall be black, roll-formed, thin-gauge, C-section steel, steel-reinforced butyl rubber, thermally broken aluminum, polyurethane and silicon foams, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in IGMA TR-1200. The units shall conform to ASTM E 773 and ASTM E 774, Class A. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

2.2.1 Buildings

Two panes of glass separated by a dehydrated airspace, filled with argon gas, filled with krypton gas, filled with aerogel and hermetically sealed.

Insulated glass units shall have a Solar Heat Gain Coefficient (SHGC) maximum of _____and a U-factor maximum of _____ Btu per square foot x hr x degree F.

Glazing shall meet or exceed a luminous efficacy of 1.0. See sections for energy performance requirements for glazed systems (glazing and frames). Glazed panels shall be rated for not less than 26, 30, 35 Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

Dimensional tolerances shall be as specified in IGMA TR-1200. The units shall conform to meet CBA Grade requirement when tested in accordance with ASTM E 773 and ASTM E 774, Class A. Spacer shall be black, roll-formed, thin-gauge, C-section steel, steel-reinforced butyl rubber, thermally

broken aluminum, polyurethane and silicon foams, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

The inner light shall be ASTM C 1172, clear annealed flat glass Type I, Class I, Quality q3, ASTM C 1036, Type I, Class 1, Quality q4, _____ inch thick, ASTM C 1048, Grade B (fully tempered), Style I (uncoated), Type I, Class 1 (transparent), Quality q4, _____ inch thick. The outer light shall be ASTM C 1036, Type I, Class 1 (transparent), 2 (tinted heat absorbing), 2 (solar-reflective), Quality q4, _____ inch thick, ASTM C 1048, Grade B (fully tempered), Style I (uncoated), Type I, Class 1 (clear), 2 (tinted heat absorbing), solar-reflective, Quality q4, _____ inch thick.

2.2.2 Control Towers

Control tower glass units shall be of sizes required to properly fit aluminum frames. Tolerances and clearances for units shall be designed to prevent the transfer of stress in aluminum frames to the glass. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, glazing sealants, and resilient channels or cemented-on-materials shall be of the type recommended in the glass manufacturer's approved written instructions. Edges and corners of units shall not be ground, nipped, cut, or fitted after leaving the factory.

2.2.2.1 Control Tower Insulating Glass

Insulating glass units for air traffic control towers shall meet the wind load design requirement of _____ psi, as determined in accordance with ASCE 7. Insulating glass shall be Class A preassembled units of dual-seal construction consisting of two lites of glass separated by a dark bronze aluminum, steel, or stainless steel, spacer with desiccant and dehydrated space conforming to ASTM E 773 and ASTM E 774. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints, to completely seal the spacer periphery to eliminate moisture and hydrocarbon vapor transmission into airspace through corners. Primary seal shall be compressed polyisobutylene. Secondary seal shall be silicone. Insulating glass units shall be fabricated for use at an elevation of _____ feet above mean sea level and _____ feet above grade. Within bottom 1/3 of one of the vertical edges of each unit, the manufacturer shall install an open 12 inch long capillary/breather tube for pressure equalization. The insulating glass units shall be free of parallax or optical distortions. The manufacturer's identifying label shall be permanently affixed to both exterior surfaces of the glass units. The insulating glass units shall be a total thickness of 1 inch consisting of two 1/4 inch thick panels and air space, or a total thickness of 1-1/4 inch consisting of two 3/8 inch thick panels and air space, or a total thickness of 1-1/2 inch consisting of two 1/2 inch thick panels and an air space, as required to meet the wind loads indicated. Glass type shall be as follows.

2.2.2.2 Control Tower Clear Insulating Glass

Clear insulating glass shall consist of two float glass panels separated by an air space and shall conform to ASTM C 1036, Type I transparent flat glass, Quality q3-glazing select. Interior glass and exterior glass shall be Class 1-clear. Glass performance shall be minimum Visible Transmittance of 87.3 percent for each panel and R-Value of 1.85 for each unit.

2.3 PLASTIC GLAZING

2.3.1 Bullet-Resistant Plastic Sheet

Cast acrylic sheet or mar-resistant polycarbonate sheet laminated with a special interlayer, and listed in UL 752 as bullet resisting, Class I, II, III, clear in color. Provide _____.

2.4 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.4.1 Putty and Glazing Compound

Glazing compound shall conform to ASTM C 669 for face-glazing metal sash. Putty shall be linseed oil type conforming to CID A-A-378for face-glazing primed wood sash. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.4.2 Glazing Compound

ASTM C 669. Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.4.3 Sealants

Provide elastomeric and structural sealants.

2.4.3.1 Elastomeric Sealant

ASTM C 920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing wood and metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units, and with plastic sheet. Color of sealant shall be white.

2.4.3.2 Structural Sealant

ASTM C 1184, Type S.

2.4.4 Joint Backer

Joint backer shall have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.4.5 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition. Channels for bullet-resistant glass shall be synthetic rubber, ASTM C 864, not less than 1/4 inch thick and sufficiently resilient to accommodate expansion and contraction while maintaining a vaportight seal between glass and frame. Channels shall be chemically compatible with plastic sheet.

2.4.6 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks shall be dense extruded type conforming to ASTM C 509 and ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer. Block color shall be black.

2.4.7 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.4.7.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

2.4.7.2 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.4.8 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

2.5 MIRROR ACCESSORIES

2.5.1 Mastic

Mastic for setting mirrors shall be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.5.2 Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 1-1/4 x 1/4 x 1/4 inch continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

2.5.3 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be

provided with clips.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

3.2.3 Installation of Wire Glass

Install glass for fire doors in accordance with installation requirements of NFPA 80.

3.3 ADDITIONAL REQUIREMENTS FOR GLAZING CONTROL TOWER WINDOWS

3.3.1 Materials and Methods of Installation

Comply with the manufacturer's warranty and written instructions, except as indicated. Install units with the heat-absorbing glass to the exterior. Secure glass in place with bolts and spring clips. The minimum clearance between bolts and edge of glass unit shall be 3/16 inch. The glass shall be edged with 3/16 inch thick continuous neoprene, vinyl, or other approved material. Trim edging after installation. The channel shapes or strips shall be firmly held against the glass by the spring action of the extruded

metal moldings. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, applicable glazing compound, and resilient channels or cemented-on materials shall be as recommended in the written instructions of the glass manufacturer, as approved.

3.3.2 Tolerances and Clearances of Units

Design to prevent the transfer of stress in the setting frames to the glass. Springing, twisting, or forcing of units during setting will not be permitted.

3.4 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted. Clean plastic sheet in accordance with manufacturer's instructions.

3.5 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Upon removal, separate protective materials for reuse or recycling. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

3.6 WASTE MANAGEMENT

Disposal and recycling of waste materials, including corrugated cardboard recycling, shall be in accordance with the Waste Management Plan. Separate float glass and reuse or recycle. Upon removal, separate protective materials and reuse or recycle. Separate tempered glass for use as aggregate or nonstructural fill. Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.

-- End of Section --

SECTION 08 91 00

METAL WALL AND DOOR LOUVERS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating
AMCA 511	(1999; R 2004) Certified Ratings Program for Air Control Devices

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603	(2002) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 366/A 366M	(1997e1) Standard Specification for Commercial Steel, Sheet, Carbon,(0.15 Maximum Percent Cold-Rolled
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall louvers

SD-03 Product Data

Metal Wall Louvers

SD-04 Samples

Wall louvers

Door louvers

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.5 COLOR SAMPLES

Colors of finishes for wall louvers and door louvers shall closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheet

ASTM A 653/A 653M, coating designation G90.

2.1.2 Aluminum Sheet

ASTM B 209, alloy 3003 or 5005 with temper as required for forming.

2.1.3 Extruded Aluminum

ASTM B 221, alloy 6063-T5 or -T52.

2.1.4 Stainless Steel

ASTM A 167, Type 302 or 304, with 2B finish.

2.1.5 Cold Rolled Steel Sheet

ASTM A 366/A 366M, Class 1, with matte finish. Use for interior louvers only.

2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. The rating shall show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Formed Metal Louvers

Formed of zinc-coated, stainless steel sheet not thinner than 16 U.S. gage, or aluminum sheet not less than 0.08 inch thick.

2.2.3 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions where indicated, for all louvers more than 5 feet in width at not more than 5 feet on centers. Provide mullions covers on both faces of joints between louvers.

2.2.4 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. For steel louvers, provide 1/2 inch square mesh, 12 or 16 gage zinc-coated steel; 1/2 inch square mesh, 16 gage copper; or 1/4 inch square mesh, 16 gage zinc-coated steel or copper bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 DOOR LOUVERS

Inverted "Y" or Inverted "V" sightproof type not less than one inch thick with matching metal trim. Louvers for exterior doors shall be weather resistant type.

2.3.1 Extruded Aluminum Door Louvers

Fabricate of 6063-T5 or -T52 aluminum alloy with a wall thickness of not less than 0.050 inch thick. Frames and trim shall be clamp-in "L" type.

2.3.2 Formed Metal Door Louvers

Fabricate of 20 U.S. gage steel sheet or sheet aluminum not less than 0.050 inch thick. Trim shall be beveled "Z" molding both sides.

2.3.3 Screens and Frames

For exterior doors, provide aluminum insect screens, 18 by 16 or 18 by 14 mesh. Mount screens in removable, rewirable frames of same material and

finish as the louvers.

2.4 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

2.5 FINISHES

2.5.1 Aluminum

Provide factory-applied anodic coating or organic coating.

2.5.1.1 Anodic Coating

Clean exposed aluminum surfaces and apply an anodized finish conforming to AA DAF-45 Designation System for Aluminum Finishes, clear (natural), M10C22A31, Architectural Class II, integral color anodized, M10C22A32, Architectural Class II, color _____.

2.5.1.2 Organic Coating

Clean and prime exposed aluminum surfaces and apply a baked enamel finish conforming to AAMA 2603, 0.8 mil minimum dry film thickness, color _____.

2.5.2 Steel

Provide factory-applied coating. Clean and phosphate treat exposed surfaces and apply rust-inhibitive primer and baked enamel finish coat, one mil minimum total dry film thickness, color _____.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Door Louvers

Install louvers in wood doors by using metal "Z" or "L" moldings. Fasten moldings to door with screws.

3.1.3 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

-- End of Section --

SECTION 09 06 90

COLOR SCHEDULE

04/06

PART 1 GENERAL

1.1 GENERAL

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color" as used herein includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, the Contractor shall propose a color for approval.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Color Schedule

One set of color boards, as soon as possible after the Contractor is given Notice to proceed, complying with the following requirements:

a. Color boards shall reflect all actual finish textures, patterns, and colors required for this contract.

b. Materials shall be labeled with the finish type, manufacturer's name, pattern, and color reference.

c. Samples shall be on size 8-1/2 by 11 inch boards with a maximum spread of size 25-1/2 by 33 inches for foldouts.

d. Samples for this color board are required in addition to samples requested in other specification sections.

e. Color boards shall be submitted to the following addresses: Construction Manager, Building 1005 Michael Road, Camp Lejeune, North Carolina.

PART 2 PRODUCTS

2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal colors from other manufacturers.

2.2 COLOR SCHEDULE

The color schedule lists the colors, patterns and textures required for exterior and interior finishes, including both factory applied and field applied colors.

2.2.1 Exterior Walls

Exterior wall colors shall apply to exterior wall surfaces including recesses at entrances and projecting vestibules. Conduit shall be painted to closely match the adjacent surface color. Wall color shall be provided to match the colors listed below.

2.2.1.1 Brick:

As indicated.

2.2.1.2 Mortar:

As indicated.

2.2.1.3 Integrally Colored, Rock/Split-Faced, Ribbed, Burnished Concrete Masonry Units:

As indicated.

2.2.1.4 Paint:

As indicated.

2.2.1.5 Metal Wall Panels, Hardware, and Associated Trim:

As indicated.

2.2.1.6 Insulation and Finish System:

As indicated.

2.2.1.7 Precast Concrete:

As indicated.

2.2.1.8 Precast Stone:

As indicated.

2.2.1.9 Glass and Glazing:

As indicated.

2.2.1.10 Cement Board Siding and Trim:

As indicated.

2.2.1.11 Cultured Stone:

As indicated.

2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

2.2.2.1 Steel Doors and Door Frames:

As indicated.

2.2.2.2 Steel Windows (mullion, muntin, sash, trim, and sill):

As indicated.

2.2.2.3 Aluminum Doors and Door Frames:

As indicated.

2.2.2.4 Aluminum Windows (mullion, muntin, sash, trim, and sill):

As indicated.

2.2.2.5 Wood Clad Windows (mullion, muntin, sash, trim, and sill):

As indicated.

2.2.2.6 Wood Stain:

As indicated.

2.2.2.7 Fascia:

As indicated.

2.2.2.8 Soffits and Ceilings:

As indicated.

2.2.2.9 Overhangs:

As indicated.

2.2.2.10 Downspouts, Gutters, Louvers, and Flashings:

As indicated.

2.2.2.11 Coping:

As indicated.

2.2.2.12 Precast Concrete Caps, and Sills:

As indicated.

2.2.2.13 Precast Stone Caps, and Sills:

As indicated.

2.2.2.14 Caulking and Sealants:

As indicated.

2.2.2.15 Stringers and Stair Framing:

As indicated.

2.2.2.16 Control Joints:

As indicated.

2.2.2.17 Expansion Joint and/or Covers:

As indicated.

2.2.2.18 Handrails:

As indicated.

2.2.2.19 Signage:

As indicated.

2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and copings, mechanical units, roof trim, pipes, conduits, electrical appurtenances, and similar items. Roof color shall be provided to match the colors listed below.

2.2.3.1 Metal:

As indicated.

2.2.3.2 Shingles:

As indicated.

2.2.3.3 EPDM:

As indicated.

2.2.3.4 Penetrations:

Shall match roof in color.

2.2.4 Interior Floor Finishes

Flooring materials shall be provided to match the colors listed below.

2.2.4.1 Carpet:

As indicated.

2.2.4.2 Carpet Tile:

As indicated.

2.2.4.3 Vinyl Composition Tile:

As indicated.

2.2.4.4 Sheet Vinyl:

As indicated.

2.2.4.5 Rubber Tile:

As indicated.

2.2.4.6 Stair Treads, Kick Strips, and Risers:

As indicated.

2.2.4.7 Quarry Tile:

As indicated.

2.2.4.8 Ceramic Tile:

As indicated.

2.2.4.9 Porcelain Tile:

As indicated.

2.2.4.10 Grout:

As indicated.

2.2.4.11 Plastic Laminate:

As indicated.

2.2.4.12 Wood:

As indicated.

2.2.4.13 Static Dissipative, Conductive Tile:

As indicated.

2.2.4.14 Concrete Paint, Stain:

As indicated.

2.2.4.15 Industrial Floor Coating:

As indicated.

2.2.5 Interior Base Finishes

Base materials shall be provided to match the colors listed below.

2.2.5.1 Resilient Base and Moldings:

As indicated.

2.2.5.2 Quarry Tile:

As indicated.

2.2.5.3 Ceramic Tile:

As indicated.

2.2.5.4 Porcelain Tile:

As indicated.

2.2.5.5 Grout:

As indicated.

2.2.5.6 Coved Sheet Vinyl:

As indicated.

2.2.5.7 Glazed Structural Units:

As indicated.

2.2.5.8 Prefaced Concrete Masonry Units:

As indicated.

2.2.5.9 Brick:

As indicated.

2.2.5.10 Mortar:

As indicated.

2.2.5.11 Paint:

As indicated.

2.2.5.12 Wood:

As indicated.

2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Wall materials shall be provided to match the colors listed below.

2.2.6.1 Paint:

As indicated.

2.2.6.2 Vinyl Wall Covering:

As indicated.

2.2.6.3 Fabric Wall Covering:

As indicated.

2.2.6.4 Acoustical Wall Covering:

As indicated.

2.2.6.5 Ceramic Tile:

As indicated.

2.2.6.6 Ceramic Tile Grout:

As indicated.

2.2.6.7 Brick:

As indicated.

2.2.6.8 Mortar:

As indicated.

2.2.6.9 Metal Liner Panels:

As indicated.

2.2.6.10 Glazed Structural Units:

As indicated.

2.2.6.11 Prefaced Concrete Masonry Units:

As indicated.

2.2.6.12 Columns:

As indicated.

2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Ceiling materials shall be provided to match the colors listed below.

2.2.7.1 Acoustical Tile and Grid:

As indicated.

2.2.7.2 Paint:

As indicated.

2.2.7.3 Metal Deck:

As indicated.

2.2.7.4 Structural Framing:

As indicated.

2.2.8 Interior Trim

Interior trim shall be provided to match the colors listed below.

2.2.8.1 Steel Doors:

As indicated.

2.2.8.2 Steel Door Frames:

As indicated.

2.2.8.3 Steel Windows (mullion, muntin, sash, trim, and stool):

As indicated.

2.2.8.4 Aluminum Doors and Door Frames:

As indicated.

2.2.8.5 Aluminum Windows (mullion, muntin, sash, trim, and sill):

As indicated.

2.2.8.6 Wood Doors:

As indicated.

2.2.8.7 Wood Stain:

As indicated.

2.2.8.8 Window Sills:

As indicated.

2.2.8.9 Fire Extinguisher Cabinets:

As indicated.

2.2.8.10 Handrails:

As indicated.

2.2.8.11 Ladders:

As indicated.

2.2.8.12 Metal Stairs:

As indicated.

2.2.8.13 Exposed Ductwork:

As indicated.

2.2.8.14 Closet Shelving:

As indicated.

2.2.8.15 Benches:

As indicated.

2.2.9 Interior Window Treatment

Window treatments shall be provided to match the colors listed below.

2.2.9.1 Horizontal Blinds:

As indicated.

2.2.9.2 Integral Blinds:

As indicated.

2.2.9.3 Vertical Blinds:

As indicated.

2.2.9.4 Drapery Hardware:

As indicated.

2.2.9.5 Window Shades:

As indicated.

2.2.10 Interior Miscellaneous

Miscellaneous items shall be provided to match the colors listed below.

2.2.10.1 Toilet Partitions and Urinal Screens:

As indicated.

2.2.10.2 Plastic Laminate:

As indicated.

2.2.10.3 Solid Surfacing Material:

As indicated.

2.2.10.4 Casework:

As indicated.

2.2.10.5 Signage Message Color (excluding handicapped signage):

As indicated.

2.2.10.6 Signage Background Color (excluding handicapped signage):

As indicated.

2.2.10.7 Operable Partitions:

As indicated.

2.2.10.8 Acoustical Wall Panels:

As indicated.

2.2.10.9 Corner Guards:

As indicated.

2.2.10.10 Wall Switch Handles and Standard Receptacle Bodies:

As indicated.

2.2.10.11 Electrical Device Cover Plates:

As indicated.

2.2.10.12 Electrical Panels:

As indicated.

2.2.10.13 Shower Curtain, Doors:

As indicated.

2.2.10.14 Shower Wall Kits, Trim and Shower Pan:

As indicated.

2.3 PLACEMENT SCHEDULE

Placement of color shall be in accordance with the following schedule:

Room: As indicated.

	Base	Floor	N Wall	S Wall	E Wall	W Wall	Ceiling
Material: As indicated.							

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 09 15 00

PLASTER AND STUCCO REPAIR

01/07

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 28	(1996el) Gypsum Plasters
ASTM C 36/C 36M	(1999) Gypsum Wallboard
ASTM C 840	(1999) Application and Finishing of Gypsum Board
ASTM C 926	(1998a) Application of Portland Cement-Based Plaster
ASTM C 932	(1980; R 1998a) Surface Applied Bonding Agents for Exterior Plastering
ASTM C 1002	(2000) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-07 Certificates

Gypsum Plaster

Gypsum Wallboard

Screws

Stucco/Portland cement lime plaster

Ready-Mixed Plaster or Stucco

Submit manufacturers certificate of conformance attesting that the materials meet the requirements specified.

1.3 ENVIRONMENTAL CONDITIONS

1.3.1 Gypsum Plaster

Maintain an ambient temperature of not less than 55 degrees F continuously

in the areas to be plastered. Maintain this temperature for not less than on week prior to the application of plaster, while performing plastering, while the plaster is drying, and after the plaster is dry until normal occupancy heating conditions are established. Distribute heat in all areas. Provide regulated ventilation to prevent "sweatouts" or "dry-outs." When the building is exposed to hot dry winds or day-to-night tem perature differentials of 20 degrees F or more, cover openings that are not glazed. Provide permanent ventilation for spaces enclosed by suspended ceilings.

1.3.2 Portland Cement-Lime Plaster/Stucco

Maintain an ambient temperature of not less than 40 degrees F continuously where plastering work will be performed. Maintain this temperature for not less than 48 hours prior to the application of plaster and stucco, while performing plastering and stuccoing, and during the curing operation. In interior plastering work, maintain heat within the building until normal occupancy conditions are established. When the building is exposed to hot dry winds or day-to-night temperature differentials of 20 degrees F or more, cover openings that are not glazed.

1.3.3 Protection from Sun and Dry Winds

During the application of the finish coat, and for a period of 48 hours following the completion of finish coat application for any given area, protect the surface of the plaster from direct sunlight and direct winds.
Use of tarpaulins or other temporary means are acceptable. Provide moist curing.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials conforming to the respective specifications and the requirements specified herein.

2.1.1 Gypsum Plaster

ASTM C 28, ready mixed plaster shall be used.

2.1.4 Gypsum Wallboard

ASTM C 36/C 36M.

2.1.5 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws. Use specially designed steel screws as recommended by the gypsum board manufacturer for the screw application of gypsum board or to steel or wood framing.

2.2 STUCCO/PORTLAND CEMENT LIME PLASTER

ASTM C 926 utilizing surface bonding agents from ASTM C 932.

2.3 PROPORTIONING AND MIXING

Except where specified otherwise, materials are specified on a volume basis

and shall be measured in approved containers, which will insure that the specified proportions will be controlled and accurately maintained during the progress of the work. Measuring materials with shovels "shovel count" will not be permitted. Ready-mix plaster shall be prepared for use by the addition of water only.

2.4 READY-MIXED PLASTER OR STUCCO

Mix in accordance with the manufacturer's printed instructions.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACES

Clean surfaces to be free of all projections, dust, loose particles, grease, bond breakers, gouges, holes, and other foreign matter. Do not apply to surfaces that have been painted or previously plastered or stuccoed. Before plaster work is started, wet underlying surfaces thoroughly with a fine fog spray of clean water to produce a uniformly moist condition. Check metal grounds, corner beads, screeds, and other accessories carefully for alignment before the work is started. Do not apply plaster or stucco to surfaces containing frost.

3.2 APPLICATION

3.2.1 GYPSUM BOARD

ASTM C 840, System VIII.

3.2.2 PLASTER/STUCCO

Shall be applied to yield a finished surface which is smooth and true to the line of existing undisturbed surface.

3.2.2 STUCCO

ASTM C 926, utilizing ASTM C 932 bonding agents.

-- End of Section --

SECTION 09 17 00

SKIM COAT REPAIR FOR PLASTER WALLS

01/07

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 587	(1997) Gypsum Veneer Plaster
ASTM C 843	(1999) Application of Gypsum Veneer Plaster

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-07 Certificates

Skim coat

Submit manufacturer's certificates of conformance attesting that the materials meet the requirements specified.

SD-08 Manufacturer's Instructions

Skim coat

Submit manufacturer's application instructions.

1.3 APPLICABILITY

Do not attempt skim coat work using this section if the plaster finish is entirely missing.

1.4 DELIVERY AND STORAGE

Deliver and store plaster materials in the manufacturer's original unopened containers. Store materials off the ground within a completely enclosed structure of enclosed within a weathertight covering.

1.5 SCHEDULING

Commence application only after the area scheduled for veneer plaster work is completely weathertight. The heating, ventilating, and air conditioning systems should be in operation prior to application of the skim coat.

1.6 ENVIRONMENTAL REQUIREMENTS

Maintain a continuous uniform temperature of not less than 50 degrees F and not more than 80 degrees F. Shield air supply and distribution devices to prevent any uneven flow of air across the skim coat surfaces. Provide ven tilation to exhaust moist air to the outside during plaster application and set until skim coat is dry. For enclosed areas lacking natural ventila tion, provide temporary mechanical means for ventilation. Avoid rapid dry ing. During periods of low humidity, provide minimum air circulation fol lowing skim coat work and until skim coat is dry.

PART 2 PRODUCTS

2.1 SKIM COAT

Gypsum veneer plaster ASTM C 587. Minimum compressive strength of finish coat plaster shall be 2500 psi.

PART 3 EXECUTION

3.1 MIXING

Clean mixer between batches to avoid accelerating the setting time. Do not add other plaster materials to modify the properties of the veneer plaster skim coat.

3.2 PREPARATION OF SURFACES

Surfaces to which the skim coat is to be applied shall be free of all pro jections, dust, loose particles, grease, bond breakers, gouges, holes, and other foreign matter. Check metal grounds, corner beads, screeds, and other accessories carefully for alignment before the work is started.

3.3 APPLICATION

Skim coat shall be applied, in accordance with ASTM C 843, to yield a finished surface which is continuous. Measure from high point to high point in the area called up for skim coat. Skim coated surfaces shall match adjacent surfaces and shall be primed prior to painting.

3.4 CLEANUP AND PATCHING

Remove plaster splashes from adjacent surfaces. Repair defects in the veneer plaster. Plaster surfaces shall be smooth, clean, and in condition to receive the finishing materials that will be applied.

-- End of Section --

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341	(2005; Supp 2001) Seismic Provisions for Structural Steel Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M	(2006) Standard Specification for Steel Sheet, Aluminum-Coated
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 645	(2007a) Nonstructural Steel Framing Members
ASTM C 754	(2004) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 841	(2003) Installation of Interior Lathing and Furring
ASTM C 847	(2006) Standard Specification for Metal Lath

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM ML/SFA 920	(1991) Metal Lathing and Furring

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2007) Fire Resistance Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal support systems

Submit for the erection of metal, framing, furring, and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A 653/A 653M, G-60; aluminum coating ASTM A 463/A 463M, T1-25; or a 55-percent aluminum-zinc coating. Provide support systems and attachments per AISC 341 and NAVFAC P-355, "Seismic Design for Buildings" in seismic zones.

2.1.1 Materials for Attachment of Lath

2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C 841, and ASTM C 847.

2.1.1.2 Non-loadbearing Wall Framing

NAAMM ML/SFA 920.

2.1.2 Materials for Attachment of Gypsum Wallboard

2.1.2.1 Suspended and Furred Ceiling Systems

ASTM C 645.

2.1.2.2 Nonload-Bearing Wall Framing and Furring

ASTM C 645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures, 0.0329 inch thickness.

2.1.2.3 Furring Structural Steel Columns

ASTM C 645. Steel (furring) clips and support angles listed in UL Fire Resistance may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

2.1.2.4 Z-Furring Channels with Wall Insulation

Not lighter than 26 gage galvanized steel, Z-shaped, with1 1/4 inch and 3/4 inch flanges and 1, 1 1/2, 2, 3 inch furring depth, depth as required by the insulation thickness provided.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Lath

3.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C 841, except as indicated otherwise.

3.1.1.2 Non-loadbearing Wall Framing

NAAMM ML/SFA 920, except provideframing members 16 inches o.c. unless indicated otherwise.

3.1.2 Systems for Attachment of Gypsum Wallboard

3.1.2.1 Suspended and Furred Ceiling Systems

ASTM C 754, except provide framing members 16 inches o.c. unless indicated otherwise.

3.1.2.2 Non-loadbearing Wall Framing and Furring

ASTM C 754, except as indicated otherwise.

3.1.2.3 Furring Structural Steel Columns

Install studs or galvanized steel clips and support angles for erection of gypsum wallboard around structural steel columns in accordance with the UL Fire Resistance, design number(s) indicated, of the fire resistance rating indicated.

3.1.2.4 Z-Furring Channels with Wall Insulation

Install Z-furring channels vertically spaced not more than 24 inches o.c. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry and concrete walls with powder-driven fasteners or hardened concrete steel nails through narrow flange of channel. Space fasteners not more than 24 inches o.c.

3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/4 inch in 8 feet from a straight line;

c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/8 inch in 8 feet from a straight line;

c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION 09 24 23

STUCCO

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 1032	(2006) Standard Specification for Woven Wire Plaster Base
ASTM C 1063	(2006) Standard Practice for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 206	(2003) Standard Specification for Finishing Hydrated Lime
ASTM C 841	(2003) Installation of Interior Lathing and Furring
ASTM C 847	(2006) Standard Specification for Metal Lath
ASTM C 897	(2005) Aggregate for Job-Mixed Portland Cement-Based Plasters
ASTM C 926	(2006) Application of Portland Cement-Based Plaster
ASTM C 933	(2007b) Welded Wire Lath

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lath

Drawings showing details of construction for reinforcement,

furring, and grounds; including manufacturer's installation instructions for stucco materials, and locations where each mix and coating thickness will be used.

SD-03 Product Data

Materials

Detailed description of the proposed job-mix proportions for base and finish coats; including identification of thickness of coats.

SD-04 Samples

Colored Stucco Finish Coat

Samples including both a fabricated portion of unit of work and color samples.

Sample Panel

Sample panel, as specified.

1.3 DELIVERY AND STORAGE

Packaged materials shall be delivered to the site in the original packages and containers with labels intact and seals unbroken. Cementitious materials shall be kept dry and stored off the ground under cover away from damp surfaces until ready to be used. Aggregate shall be covered to prevent the absorption or loss of moisture.

1.4 ENVIRONMENTAL CONDITIONS

Stucco shall not be applied when the ambient temperature is 40 degrees F or lower, or when a drop in temperature below 40 degrees F is expected within 48 hours after application.

1.5 SAMPLE PANEL

The Contractor shall submit: One 12 inch square stucco panel showing finish texture and color and exposed reinforcement at the edges, one 12 inch square of reinforcement, and a 12 inch length of each accessory proposed, prior to proceeding with stucco work. A sample panel of stucco, constructed at the jobsite, and located as directed, to demonstrate installation procedures, texture and color, prior to proceeding with any stucco work. Panel size shall be a minimum of 4 feet wide x 8 feet high; shall contain each type accessory proposed for use and shall be constructed in the vertical position. Sample panel shall have exposed reinforcement at the edges. Each phase of installation such as framing, scratch coat, brown coat, finish coat and curing procedures shall be demonstrated in the construction of the panel. One 12 inch square of reinforcement and one 12 inch length of each accessory proposed for use, shall be submitted prior to constructing the sample panel.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT

Portland cement shall conform to ASTM C 150, gray portland cement Type I,

II, III, white portland cement, Type I, II, III.

2.2 COLORED STUCCO FINISH COAT

Colored stucco finish coat shall be a mill mixed product using white portland cement and requiring only the addition of and mixing with water for application. Color shall be in accordance with Section 09 06 90COLOR SCHEDULE, as indicated.

2.3 LIME

Lime shall conform to ASTM C 206, Type S.

2.4 SAND

Sand aggregate for job-mixed base coat and job-mixed finish coat stucco shall conform to ASTM C 897.

2.5 ACCESSORIES

Accessories shall be roll formed galvanized steel, except that cornerite and striplath shall be formed from steel sheets with manufacturer's standard galvanized coating. Welded wire corner reinforcements shall be zinc coated, galvanized 17 gauge steel wire conforming to ASTM A 185/A 185M. Furring shall include hangers, bolts, inserts, clips, fastenings, and attachments of number, size, and design to develop the full strength of the members.

2.6 STEEL FRAMING

Steel framing shall be as shown and shall be manufacturers standard products with shop applied protective coating.

2.7 METAL LATH

Metal lath shall conform to ASTM C 847, types and weights in accordance with the various spacing shown in ASTM C 841. Lath for vertical application on steel and wood framing supports shall be expanded metal or welded or woven wire and shall have paper backing with a minimum vapor permeance of 5 perms. Woven wire lath shall be a maximum 1-1/2 x 1-1/2 inch mesh wire of not less than 0.0540 inch nominal diameter and shall conform to ASTM C 1032. Welded wire lath shall conform to ASTM C 933, with openings not to exceed 2 x 2 inches. Expanded metal or wire lath shall be fabricated in a manner to provide not less than 1/4 inch keying between wire and paper backing and keying shall be obtained by a uniform series of slots in a perforated face paper woven between the wires.

2.8 WATER

Water shall be clean, fresh, potable, and free from amounts of oils, acids, alkalis and organic matter that would be injurious to the stucco.

PART 3 EXECUTION

3.1 FRAMING

Framing shall be installed as indicated.

3.2 CONTROL JOINTS

Control joints shall be located as indicated on the drawings. Prefabricated control joint members shall be installed prior to the application of the stucco. Control joints shall be cleared of all stucco within the control area after stucco application and prior to final stucco set.

3.3 LATH

Lath shall be installed in accordance with ASTM C 841 or ASTM C 1063 except as otherwise specified. Metal and wire lath shall be applied straight, without buckles and with joints staggered. End laps of metal lath shall be not less than 1 inch. When paper-backed lath is used, the paper shall be split from the lath at all lap areas to provide a paper to paper and lath to lath lap. Horizontal joints shall be shiplapped. Lath shall be interrupted at all control joints.

3.3.1 Steel and Wood Supports

Metal lath without integral backing over vertical open or solid wood and steel backing frame construction shall be applied only after a backing of shiplapped waterproofed building paper or other approved material has been applied to the area to receive the stucco. Lath shall be secured to the wood frames with nails or staples spaced not over 6 inches on centers along each support; and where sheets of lath are lapped, fasteners shall be driven so as to hold both lapped edges securely in place. Lath shall be secured to steel frames in accordance with ASTM C 841 or ASTM C 1063, as applicable.

3.3.2 On Concrete and Masonry

Lath shall be fastened every 8 inches vertically and every 16 inches horizontally. Where wood supports adjoin masonry or concrete in the same direction, casing bead, control joints, or reinforcement shall be provided as indicated.

3.3.3 Over Metal Lintels and Flashings

Lath over metal lintels shall be extended vertically over the angles to a height of not less than 6 inches and horizontally across the underside of the lintels and shall be secured in an approved manner. Lath over metal flashings shall lap the flashings not less than 2 inches and shall be extended vertically for a height of not less than 6 inches.

3.3.4 Special Shapes, Profiles, and Contours

Special shapes, profiles, and contours shall be formed with wood, metal or aluminum furring and reinforcing.

3.4 FURRING

Furring shall be installed to true lines and surfaces and shall be rigidly supported and secured in place.

3.5 PREPARATION OF SURFACES

Preparation of surfaces for application of stucco to solid bases such as stone, masonry or concrete shall conform to the applicable requirements of

ASTM C 926.

3.6 PROPORTIONS AND MIXING

Proportions and mixing for job-mixed base coat and finish coat shall conform to the applicable requirements of ASTM C 926. Mixing of mill-mixed finish coat shall be in accordance with the manufacturer's directions.

3.7 STUCCO APPLICATION

Stucco shall be applied in three coats to a thickness of not less than 1 inch as measured from the back plane of metal reinforcement, exclusive of ribs or dimples or from the face of solid backing or support, with or without metal reinforcement, to the finished stucco surface, including moderate texture variations. Stucco application shall conform to the applicable requirements of ASTM C 926 and the following:

3.7.1 Workmanship

Items or features of the work in connection with or adjoining the stucco shall be in place, plumb, straight, and true prior to beginning the stucco work. Metal and wire lath, where required, shall be in place and positioned to provide a good key at back of lath. Where lath is applied over copper, the copper shall be given a heavy coat of bituminous paint. Masonry surfaces to receive stucco shall be evenly dampened immediately prior to application of stucco. Each stucco coat shall be applied continuously in one general direction, without allowing mortar to dry at edges. Where it is impossible to work the full dimension of a wall surface in a continuous operation, jointing shall be made at a break, opening, or other natural division of the surface. Edges to be joined shall be dampened slightly to produce a smooth confluence. Exterior corners of stucco shall be slightly rounded. Stucco on soffit surfaces shall be pitched forward to form a drip.

3.7.2 Scratch Coat

Scratch coat shall be applied not less than 3/8 inch thick under sufficient pressure to form good keys and to completely embed the reinforcement. Before the scratch coat has set, it shall be lightly scratched in one direction and vertical surfaces shall be scratched in the horizontal direction only. The scratch coat shall be fog cured for a minimum of 72 hours.

3.7.3 Brown Coat

The scratch coat shall be dampened evenly to obtain uniform suction before the brown coat is applied. There shall be no visible water on the surface when the brown coat is applied. The brown coat shall be applied to the scratch coat with sufficient pressure to force the stucco into the scratches and shall be brought to a plumb, true, even plane with rod or straightedge. When set sufficiently, the brown coat shall be uniformly floated with a dry float to promote densification of the coat and to provide a surface receptive to bonding of the finish coat. Brown coat shall be fog cured for a minimum of 72 hours.

3.7.4 Finish Coat

Surfaces of the brown coat shall be dampened not more than 1 hour before the finish coat is to be applied to a uniform wetness with no free-standing

water on the surface. The finish coat shall have a smooth trowel, float, trowel-textured, rough-textured, spray-textured, exposed aggregate finish and shall conform to the approved sample. The finish coat shall be fog cured for a minimum of 48 hours. Care shall be taken to prevent staining.

3.7.5 Surface Tolerance

When a 10 foot straightedge is placed at any location on the finished surface of the stucco, excluding rough-textured finish, the surface shall not vary more than 1/8 inch from the straightedge.

3.8 CURING AND PROTECTION

Fog curing shall be accomplished by applying a fine mist of water to the stucco. Care shall be exercised during fog curing to avoid erosion damage to the stucco surfaces. A solid stream of water shall not be used. Frequency of fogging shall be not less than three times daily. When directed the Contractor shall protect the stucco from the direct rays of the sun during severe drying conditions using canvas, cloth or other approved sheet material.

3.9 PATCHING AND POINTING

Loose, cracked, damaged or defective work shall be replaced or patched as directed. Patching shall match existing work in texture and color and shall be finished flush.

-- End of Section --

SECTION 09 27 00

SKIM COAT REPAIR FOR GYPSUM BOARD WALLS

01/07

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 840	(1999) Application and Finishing of Gypsum Board

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-07 Certificates

Skim coat

Submit manufacturer's certificates of conformance attesting that the materials meet the requirements specified.

SD-08 Manufacturer's Instructions

Skim coat

Manufacturer's application instructions.

1.3 APPLICABILITY

If the surface paper layer is missing -- do not attempt a skim coat.

1.4 DELIVERY AND STORAGE

Deliver and store materials in the manufacturer's original unopened con tainers. Store materials off the ground within a completely enclosed structure or enclosed within a weathertight covering.

1.5 SCHEDULING

Commence application only after the area scheduled for skim coat is com pletely weathertight. The heating, ventilating, and air conditioning sys tems shall be complete and in operation prior to application of the skim coat.

1.6 ENVIRONMENTAL REQUIREMENTS

Maintain a continuous uniform temperature of not less than 50 degrees F and not more than 80 degrees F prior to the application of skim coat and for at least on week after. Shield air supply and distribution devices to prevent any uneven flow of air across the skim coat. Provide ventilation to exhaust moist air to the outside during application and set, and until skim coat is dry. In glazed areas, keep windows open top and bottom or side to side 3 to 4 inches. Openings can be reduced in cold weather. For enclosed areas lacking natural ventilation, provide temporary mechanical means for ventilation. In unglazed areas subjected to hot, dry winds or temperature differentials from day to night of 20 degrees F or more, screen openings with cheesecloth or similar materials. Avoid rapid drying. During periods of low indoor humidity, provide minimum air circulation following skim coat work and until skim coat is dry.

PART 2 PRODUCTS

2.1 SKIM COAT

ASTM C 475.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACES

Surfaces to which the skim coat is to be applied shall be free of all pro jections, dust, loose particles, grease, bond breakers, gouges, holes, and other foreign matter. Check metal grounds, corner beads, screeds, and other accessories carefully for alignment before the work is started.

3.2 APPLICATION

Skim coat shall be applied in accordance with ASTM C 840 to yield a finished surface which is continuous, allowing a tolerance of not more than 1/16-inch difference in the surface over any 24-inch area, measured from high point to high point in the areas called up for skim coat. Skim coated surfaces shall match adjacent surfaces and shall be primed prior to paint ing.

3.3 CLEANUP AND PATCHING

Remove skim coat splashes from adjacent surfaces. Repair defects in the skim coat.

-- End of Section --

SECTION 09 29 00

GYPSUM BOARD

10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992) Interior Installation of Cementitious Backer Units
ANSI/CTI A108/A118/A136.1	(2005) Specification for the Installation of Ceramic Tile

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1002	(2007) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C 1047	(2005) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1177/C 1177M	(2006) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1178/C 1178M	(2006) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C 1396/C 1396M	(2006a) Standard Specification for Gypsum Board
ASTM C 36/C 36M	(2003e1) Gypsum Wallboard
ASTM C 442/C 442M	(2004e1) Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board
ASTM C 475/C 475M	(2002; R 2007) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(2004) Standard Specification for Nails for the Application of Gypsum Board
ASTM C 557	(2003e1) Adhesives for Fastening Gypsum Wallboard to Wood Framing

ASTM C 630/C 630M	(2003e1) Water-Resistant Gypsum Backing Board
ASTM C 79/C 79M	(2004a) Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM C 840	(2007) Application and Finishing of Gypsum Board
ASTM C 954	(2007) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C 960/C 960M	(2004) Predecorated Gypsum Board
ASTM D 1037	(2006a) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D 1149	(2007) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 2394	(2005) Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D 412	(2006a) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 5420	(2004) Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Strike Impacted by a Falling Weight (Gardner Impact)
ASTM D 624	(2000e1) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 695	(2003) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board

	Finish
GA 216	(2004) Application and Finishing of Gypsum Board
GA 224	(1997) Installation of Predecorated Gypsum Board
GA 253	(1999) Application of Gypsum Sheathing
GA 600	(2003) Fire Resistance Design Manual

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2007) Fire Resistance Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cementitious backer units

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board

Glass Mat Covered or Reinforced Gypsum Sheathing

Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Impact Resistant Gypsum Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

Gypsum Board; (LEED)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Adhesives; (LEED)
Joint Treatment Materials

Submit manufacturer's product data, indicating VOC content.

Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

SD-04 Samples

Predecorated gypsum board

Submit for each color and pattern of predecorated gypsum board. Where colors are not indicated, submit color selection samples of not less than eight of the manufacturer's standard colors.

SD-07 Certificates

Asbestos Free Materials

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer maintenance instructions

Waste Management

SD-11 Closeout Submittals

Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Gypsum Board; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives; (LEED)

LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Gypsum wallboard shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.4.3 Temporary Ventilation

Provide temporary ventilation for work of this section.

1.5 SUSTAINABLE DESIGN REQUIREMENTS

1.5.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Gypsum board materials may be locally available.

1.5.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

1.6 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

1.7 SCHEDULING

The gypsum wall board shall be taped, spackled and primed before the installation of the highly-emitting materials. The gypsum wallboard shall be installed after the installation and ventilation period of the highly-emitting materials.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only. Submit Material Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M. Gypsum board shall contain a minimum of 5 percent post-consumer recycled content, or a minimum of 10 percent post-industrial recycled content. Gypsum cores shall contain a minimum of 95 percent post-industrial recycled gypsum content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Gypsum board may contain post-consumer or post-industrial recycled content.

2.1.1.1 Regular

48 inch wide, 5/8 inch thick, tapered, tapered and featured edges. Provide tapered and featured edge gypsum board as indicated.

2.1.1.2 Foil-Backed

48 inch wide, 5/8 inch thick, tapered, tapered and featured edges.

2.1.1.3 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered, tapered and featured edges.

2.1.2 Gypsum Backing Board

ASTM C 442/C 442M, gypsum backing board shall be used as a base in a multilayer system.

2.1.2.1 Regular

48 inch wide, 5/8 inch thick, square edges.

2.1.2.2 Foil-Backed

48 inch wide, 5/8 inch thick, square edges.

2.1.2.3 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, square edges.

2.1.3 Regular Water-Resistant Gypsum Backing Board

ASTM C 630/C 630M

2.1.3.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.3.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.4 Glass Mat Water-Resistant Gypsum Tile Backing Board

ASTM C 1178/C 1178M

2.1.4.1 Regular

48 inch wide, 5/8 inch thick, square edges.

2.1.4.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, square edges.

2.1.5 Glass Mat Covered or Reinforced Gypsum Sheathing

Exceeds physical properties of ASTM C 79/C 79M and ASTM C 1177/C 1177M. Provide 1/2, 5/8 inch, gypsum sheathing. Provide gypsum board of with a noncombustible water-resistant core, with glass mat surfaces embedded to the gypsum core or reinforcing embedded throughout the gypsum core. Warrant gypsumsheathing board for at least six months against delamination due to direct weather exposure. Provide continuous, asphalt impregnated, building felt to cover exterior face of sheathing. Seal all joints, seams, and penetrations with compatible sealant.

2.1.5.1 Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Provide sealant compatible with gypsum sheathing, rubber washers for masonry veneer anchors, and other associated cavity wall components such as anchors and through wall flashing. Provide sealants for gypsum sheathing board edge seams and veneer anchor penetrations recommended by the gypsum sheathing manufacturer and have the following performance requirements:

a. ASTM D 412: Tensile Strength - 80 psi
b. ASTM D 412: Ultimate Tensile Strength (maximum elongation) - 170 psi
c. ASTM D 624: Tear Strength, dieB, - 27 ppi
d. ASTM D 1149: Joint Movement Capability after 14 Days cure - plus or minus 50 percent.

2.1.6 Impact Resistant Gypsum Board

48 inch wide, 5/8 inch thick, tapered edges.
Reinforced gypsum panel with imbedded fiber mesh or lexan backing testing in accordance with the following tests. Provide fasteners that meet

manufacturer requirements and specifications stated within this section. Impact resistant gypsum board, when tested in accordance with ASTM E 84, have a flame spread rating of 25 or less and a smoke developed rating of 50 or less for _____ and a flame spread rating of 75 or less and a smoke developed rating of 100 or less for _____.

2.1.6.1 Structural Failure Test

ASTM E 695 or ASTM D 2394 for structural failure (drop penetration). ASTM E 695 using a 60 lb sand filled leather bag, resisting no less than 300 ft. lb. cumulative impact energy before failure or ASTM D 2394 using 5.5 inch hemispherical projectile resisting no less than 264 ft. lb. before failure. Provide test specimen stud spacing a minimum 16 inch on center.

2.1.6.2 Indentation Test

ASTM D 5420 or ASTM D 1037 for indentation resistance. ASTM D 5420 using a 32 oz weight with a 5/8 inch hemispherical impacting head dropped once 3 feet creating not more than 0.137 inch indentation or ASTM D 1037 using no less than 470 lb weight applied to the 0.438 inch diameter ball to create not more than a 0.0197 inch indentation depth.

2.1.7 Predecorated Gypsum Board

ASTM C 960/C 960M, regular, Type X gypsum board, 48 inch wide, 5/8 inch thick, with a decorative wall covering (Class I) or coating (Class II) applied in-plant by the gypsum board manufacturer. The color and pattern of wall covering shall be as selected. Provide color and pattern wall covering selected. Furnish gypsum board with square edges, and a slight bevel to produce a shallow vee joint. Wrap all coverings around edges. Furnish a predecorated gypsum board with a flame spread rating of 25 or less and a smoke developed rating of 50 or less for _____ and a flame spread rating of 75 or less and a smoke developed rating of 100 or less for _____.

2.1.8 Cementitious Backer Units

ANSI/CTI A108/A118/A136.1.

2.1.9 Joint Treatment Materials

ASTM C 475/C 475M. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

2.1.9.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.9.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.9.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.9.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.9.5 Joint Tape

Use cross-laminated or tapered edge tape recommended by the manufacturer. Paper and fiberglass joint tape are not permitted.

2.1.10 Fasteners

2.1.10.1 Nails

ASTM C 514. For predecorated gypsum board provide special nails with factory coated heads of color to match wall covering materials as recommended by the predecorated gypsum board manufacturer.

2.1.10.2 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.10.3 Staples

No. 16 USS gage flattened galvanized wire staples with 7/16 inch wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

Length of Legs (inch)	Thickness of Gypsum Board (inch)
1 1/8	1/2
1 1/4	5/8

2.1.11 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene. Adhesive shall contain a maximum VOC content of 50 grams per liter. Adhesive must meet the requirements of LEED low emitting materials credit.

2.1.11.1 Adhesive for Fastening Gypsum Board to Metal Framing

Not permitted. Type recommended by gypsum board manufacturer.

2.1.11.2 Adhesive for Fastening Gypsum Board to Wood Framing

Not permitted. ASTM C 557.

2.1.11.3 Adhesive for Laminating

Not permitted. Adhesive attachment is not permitted for multi-layer gypsum boards. For laminating gypsum studs to face panels, provide adhesive recommended by gypsum board manufacturer.

2.1.12 Gypsum Studs

Provide one inch minimum thickness and 6 inch minimum width. Studs may be of one inch thick gypsum board or multilayers fastened to required thickness. Conform to ASTM C 36/C 36M or ASTM C 442/C 442M for material.

2.1.13 Shaftwall Liner Panel

ASTM C 442/C 442M. Conform to the UL Fire Resistance for the Design Numbers(s) indicated for shaftwall liner panels. Manufacture liner panel for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 1", 3/4" thick, by 24" wide.

2.1.14 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials. For predecorated gypsum board provide prefinished metal or plastic trim to match predecorated gypsum board.

2.1.15 Asphalt Impregnated Building Felt

Provide a 15 lb asphalt moisture barrier over gypsum sheating. Conforming to ASTM D 226 Type 1 (No. 15) for asphalt impregnated building felt.

2.1.16 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 Gypsum Board and Framing

Verify that surfaces of gypsum board and framing to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.1.3 Masonry and Concrete Walls

Verify that surfaces of masonry and concrete walls to receive gypsum board applied with adhesive are dry, free of dust, oil, form release agents, protrusions and voids, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may not be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Minimize framing by floating corners with single studs and drywall clips. Install 5/8 inch gypsum or 1/2 inch ceiling board over framing at 24 inches on center. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Single-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C 840, System I or GA 216.

3.2.2 Application of Two-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C 840, System II or GA 216.

3.2.3 Adhesive Nail-On Application to Wood Framing

Apply in accordance with ASTM C 840, System III or GA 216. This method may be used in lieu of ASTM C 840, System I at the option of the Contractor.

3.2.4 Semi-Solid Gypsum Board Partitions

Provide in accordance with ASTM C 840, System IV or GA 216 .

3.2.5 Solid Gypsum Board Partitions

Provide in accordance with ASTM C 840, System V or GA 216.

3.2.6 Adhesive Application to Interior Masonry or Concrete Walls

Apply in accordance with ASTM C 840, System VI or GA 216.

3.2.7 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.2.8 Arches and Bending Radii

Apply gypsum board in accordance with ASTM C 840, System IX or GA 216.

3.2.9 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply glass mat water-resistant gypsum tile backing board or water-resistant gypsum backing board in accordance with

ASTM C 840, System X or GA 216.

3.2.10 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with ASTM C 840, System XI or GA 216.

3.2.11 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

Apply gypsum sheathing in accordance to gypsum association publications GA 253. Follow gypsum sheathing manufacturer's requirements of design details for joints and fasteners and be properly installed to protect the substrate from moisture intrusion. Do not leave exposed surfaces of the gypsum sheathing beyond the manufacturer's recommendation without a weather barrier cladding. Provide continuous asphalt impregnated building felt over sheathing surface in single fashion with edges and ends lapped a minimum of 6 inch. Property flash the openings. Seal all joints, seams, and penetrations with a compatible silicone sealant.

3.2.12 Floating Interior Angles

Minimize framing by floating corners with single studs and drywall clips. Locate the attachment fasteners adjacent to ceiling and wall intersections in accordance with ASTM C 840, System XII or GA 216, for single-ply and two-ply applications of gypsum board to wood framing.

3.2.13 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C 840, System XIII or GA 216. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

3.2.14 Application of Foil-Backed Gypsum Board

Apply foil-backed gypsum board in accordance with ASTM C 840, System XIV or GA 216.

3.2.15 Application of Predecorated Gypsum Board

Apply predecorated gypsum board in accordance with GA 224. Attach predecorated gypsum board with adhesive and fasteners as recommended by the manufacturer. Conceal fasteners in the finished work.

3.2.16 Application of Impact Resistant Gypsum Board

Apply in accordance with applicable system of ASTM C 840 as specified or GA 216. Follow manufacturers written instructions on how to cut, drill and attach board.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. Place a 15 lb asphalt impregnated, continuous felt paper membrane behind cementitious backer units, between backer units and studs or base layer of gypsum board. Place membrane with a minimum 6 inch overlap of sheets laid

shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile to Level 2 in accordance with GA 214. Finish walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.4.2 Metal Trim for Predecorated Gypsum Board

Finish edges, ends, and joints of predecorated gypsum board, except prefinished vee joints and monolithic type joints, with metal or plastic trim selected to match the gypsum board finish.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07920 JOINT SEALANTS Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.5.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply silicone sealant in a 3/8 inch bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. Do not place construction and materials behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and

application methods, including types and spacing of fasteners, wall and ceiling framing in accordance with the specifications contained in UL Fire Resistance for the Design Number(s) indicated, or GA 600 for the File Number(s) indicated. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes. Remove predecorated gypsum board which cannot be restored to like-new condition. Provide new predecorated gypsum board.

3.8 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

3.9 WASTE MANAGEMENT

As specified in Waste Management Plan and as follows. Separate clean waste gypsum products from contaminants. Do not include wood, plastic, metal, asphalt-impregnated gypsum board, or any gypsum board coated with glass fiber, vinyl, decorative paper, or other finish. Place in designated area and protect from moisture and contamination. Coordinate with Section 32 05 33 LANDSCAPE ESTABLISHMENT to identify requirements for gypsum soil amendment and to prepare scrap gypsum board for use as soil amendment.

Identify manufacturer's policy for collection or return of remaining construction scrap, unused material, demolition scrap, and packaging material. Institute demolition and construction recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials.

-- End of Section --

SECTION 09 29 10

CEMENT BOARD

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A 108.5	(1992)Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
ANSI A 108.10	(1992) Installation of Grout in Tilework
ANSI A 118.4	(1992) Latex-Portland Cement Mortar

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 177	(1985; R 1997) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
ASTM C 473	(20003) Physical Testing of Gypsum Panel Products
ASTM C 666	(1997) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 947	(1999) Flexural Properties of Thin-Section Glass-Fiber-Reinforced Concrete (Using Simple Beam with Third-Point Loading)
ASTM C 954	(2000) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C 1002	(2000) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 2394	(1994) Simulated Service Testing of Wood and Wood-Base Finish Flooring

ASTM E 72	(1998) Conducting Strength Test of Panels for Building Construction
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 136	(1999) Behavior of Materials in Vertical Tube Furnace at 750 Degrees C
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS UU-B-790	(Rev. A; Notice 2) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellant, and Fire Resistant)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD 810	(Rev F) Environmental Test Methods and Engineering Guidelines

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-03 Product Data

Cement board

Fasteners

Joint reinforcement

Sealants

Accessories

Submit for each type of cement board.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store board outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

Neatly stack board flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of board and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

PART 2 PRODUCTS

2.1 CEMENT BOARD

Shall be minimum 1/2-inch thick, 48-inch wide, 8-feet long; non-combustible Portland Cement product designed and manufactured especially for exterior application. Board shall be formed of an aggregated Portland Cement core faced on both surfaces and wrapped on long edges with an embedded polymer-coated glass-fiber mesh. Bonding surface shall have rough texture. Cement board shall comply with the following performance requirements:

Property	Requirements	Test Method
- Flexural Strength	min. 750 psi	ASTM C 947
- Compressive Strength	min. 1250 psi	ASTM D 2394
- Resistance of Panel Joints to Cracking	No cracking	ASTM E 72
- Non-Combustibility	Pass	ASTM E 136
- Flame Spread/Smoke	max 5/0	ASTM E 84
- Water Absorbtion	max 15 percent (24 hours)	ASTM C 473
- Fastener Pull Resistance	min 120 pounds (wet or dry)	ASTM C 473

2.2 WATERPROOFING MEMBRANE

Vapor permeable water resistant membrane meeting FS UU-B-790, such as ASTM D 226, #15 Asphalt Felt, Grade-D 60 minute Building Paper or equivalent.

2.3 FASTENERS

2.3.1 Steel Framing

Steel screws per ASTM C 954 with anti-corrosive coating, 1 5/8-inch long, #8 size, 0.4-inch diameter wafer head with drill point for 14 to 20 gauge steel framing.

2.3.2 Wood Framing

Steel screws per ASTM C 1002 with anti-corrosive coating, 1 5/8-inch to 2 1/4-inch long, #8 size, 0.4-inch diameter wafer head, Hi-Lo threads with drill or piercing point. Roofing type nails shall not be used.

2.4 ACCESSORIES

2.4.1 Metal Trim

1/2-inch J trim, 1/2-inch L trim and corner bead manufactured from zinc or other as recommended by cement board manufacturer.

2.4.2 Control Joint

Roll formed zinc or other as recommended by cement board manufacturer, with 1/4-inch wide by 7/16-inch deep slot, covered with plastic tape to be removed after finish applied.

2.5 SEALANTS

As recommended by sealant manufacturer for specific application. For synthetic stucco, use a low modulus sealant compatible with stucco finish.

2.6 FLASHING

Specify durable, corrosion resistant material in keeping with flashing spe cified in other sections.

2.7 JOINT REINFORCEMENT

2.7.1 Reinforcing Tape

Minimum 4-inch wide, polymer coated, open mesh glass fiber tape as recom mended by cement board manufacturer.

2.7.2 Tape Embedding Material

For use under:

a. Tile and Thin Brick: ANSI A 118.4, portland cement latex for tified mortar, ready-to-mix containing dry latex polymers.

b. Synthetic Stucco: Ready-to-mix portland cement mortar base coat containing dry latex polymers, approved for use by manufacturer of cement board.

2.8 TILE BACKER BOARD, SKIM COAT OR BOND COAT

ANSI A 118.4, portland cement latex fortified mortar, ready-to-mix containing dry latex polymers.

2.9 BRICK FINISH SKIM COAT OR BOND COAT

Portland cement latex fortified mortar per ANSI A 118.4, ready-to-mix, containing dry latex polymers.

2.10 SYNTHETIC STUCCO FINISH

2.10.1 Base Coat

Ready-to-mix, portland cement mortar, containing dry latex polymers and approved for use by manufacturer of cement board.

2.10.2 Finish Coat

Pre-colored, ready-mixed, elastomeric, texture coating based on a 100 per cent acrylic polymer emulsion approved for use by manufacturer of cement board.

2.10.3 Synthetic Stucco Finish

Shall comply with the following performance requirements:

Property	Requirements	Test Method
- Surface Burning Characteristics	Class A	ASTM E 84
- Bond Strength (with cement board)	50 psi	ASTM C 297
- Freeze/Thaw Resistance (with cement board)	100 Cycles no damage	ASTM C 666 proc. B
- Mildew/Fungus resistance	no growth after 28 days	MIL-STD 810
- Accelerated Weathering	2000 hours no deterioration	ASTM G 23
- Thermal "R" Value	0.26	ASTM C 177

PART 3 EXECUTION

3.1 INSPECTION

Examine framing, opening supports and conditions under which this work is to be performed. Notify Contracting Officer in writing of conditions detrimental to the proper completion of this work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

3.2.1 Framing

Components shall be sized and erected in accordance with applicable build

ing code requirements and load tables and specifications of framing manu facturer. Space framing at 16-inch o.c.

3.2.2 Water Barrier

Apply directly to framing with staples, tape or adhesives as required, immediately before erection of cement board. Lap all joints a minimum of 2-inches, shingle fashion to maintain water barrier.

3.2.3 Fastening

Fasten to framing with rough side out, over water barrier, with fasteners at 8-inch o.c., for walls and 6-inch o.c. for ceilings and soffits and with perimeter fasteners 3/8- to 5/8-inch from ends and edges. Fit ends and edges closely but do not force together. In horizontal application, stag ger end joints in successive courses with all joints occurring over framing. Start fasteners at middle of board, working toward ends and sides while holding board tight against framing. Drive fasteners so that bottom of heads are flush with surface of board.

3.2.4 Control Joints

See details for building control joints and surface control joints. Install surface control joints as follows:

a. Tile and Block: Install at 16-feet o.c. maximum in either direction, or at a lesser spacing as recommended by tile and brick manufacturer, erecting the vertical joints first per cement board manufacturer's directions. Leave a 1/2-inch minimum, continuous gap between board panels to receive zinc control joint or sealant backer and sealant as detailed.

b. Synthetic Stucco: Install at 20-feet o.c. maximum in either direction, erecting the vertical joints first per cement board per manufacturer's directions. Leave a 1/2-inch minimum, continuous gap between board panels to receive zinc control joint as detailed.

3.2.5 Flashing

Install over windows, doors, other openings and locations as detailed to direct water to outside of building.

3.2.6 Sealants

Caulk all intersections of cement board with windows, doors, control joints, other openings and locations, as detailed.

3.2.7 Trim Accessories

Fasten trim to cement board at locations indicated with galvanized roofing nails or non-corrosive screws or staples at 6- to 9-inches o.c. in each flange.

3.2.8 Joint Reinforcement

3.2.8.1 Tile and Brick

Pre-fill cement board joints and trim with latex fortified mortar mixed according to manufacturer's directions. Immediately embed reinforcing tape

into wet mortar, smoothing and leveling joints. Cure for a minimum of four hours before application of skim coat over entire surface.

3.2.8.2 Synthetic Stucco

Pre-fill cement board joints and trim with stucco base coat mixed according to manufacturer's directions. Immediately embed reinforcing tape into wet base coat, smoothing and leveling joints. Cure for a minimum of four hours before application of base coat over entire surface.

3.2.9 Skim Coat/Base Coat

3.2.9.1 Tile and Thin Brick

Apply skim coat of latex fortified mortar a minimum of 1/8-inch thick uniformly smooth and flat over entire surface. Dampen board surface as necessary under rapid drying conditions. Cure a minimum of 24 hours before application of a bond coat for setting tile or thin brick.

3.2.9.2 Synthetic Stucco

Apply base coat a minimum of 1/16-inch uniformly smooth and flat over the entire surface including joints and trim. Dampen board surface as necessary under rapid drying conditions. Cure for a minimum of 24 hours before application of synthetic stucco finish.

3.2.10 Finish Surfacing

3.2.10.1 Tile and Brick

Install according to ANSI A 108.5 and manufacturer's directions. Apply latex fortified mortar bonding coat, using appropriate notched trowel for tile or thin brick finish. Dampen skim coat as necessary under rapid drying conditions. Back butter tile or thin brick for 100 percent mortar contact. Install tile by firmly pressing into freshly notched mortar. Use a sliding and twisting motion to embed units and obtain a 100 percent contact. Maintain joint alignment and spacing. Beat tiles into place with beating blocks to close up grooves in the mortar left by trowel teeth. For best results, a minimum 3/32-inch of mortar under tile is recommended.

3.2.10.2 Latex Fortified Grout

Apply latex fortified grout in accordance with ANSI A 108.10 after tile mortar has firmly set for 24 hours. Fill and compress joints solidly with grout and tool to provide specified appearance. Clean any grout from finish surfaces. Cure as required by ANSI A 108.10 and manufacturer's directions.

3.2.10.3 Synthetic Stucco

Trowel apply ready-mixed exterior finish to base coat, texturing surface as specified, to maintain a uniform thickness of 1/16- to 3/16-inch. Dampen base coat as necessary under rapid drying conditions. Joinings between batches shall occur at surface breaks such as corners, control joints, windows, etc.

3.3 CAULKING

Caulk openings around pipes, fixtures, and other items projecting through

gypsum board as specified in Section 07 92 00, "Joint Sealants". Apply calking material with exposed surface flush with gypsum board.

3.4 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

3.5 CLEAN UP

Remove surplus material from job-site and dispose of debris as directed by Contracting Officer.

-- End of Section --

SECTION 09 30 00

CERAMIC TILE, QUARRY TILE, AND PAVER TILE

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 1026	(1987; R 2002) Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1999; R 2004) Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(2007) Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C 1178/C 1178M	(2006) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 206	(2003) Standard Specification for Finishing Hydrated Lime
ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 241	(1990; R 2005) Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 373	(1988; R 2006) Water Absorption, Bulk

	Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 482	(2002) Bond Strength of Ceramic Tile to Portland Cement
ASTM C 501	(1984; R 2002) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 648	(2004) Breaking Strength of Ceramic Tile
ASTM C 847	(2006) Standard Specification for Metal Lath
ASTM D 2103	(2005) Standard Specification for Polyethylene Film and Sheeting
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4068	(2001) Chlorinated Polyethylene Sheeting fore Concealed Water-Containment Membrane
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM F 446	(1985; R 2004e1) Grab Bars and Accessories Installed in the Bathing Area
GREEN SEAL (GS)	
GS-36	(2000) Commercial Adhesives
MARBLE INSTITUTE OF AMERICA (MIA)	
MIA Design Manual	(2003) Dimension Stone Design Manual
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 99	(2005; Errata 2005) Health Care Facilities
SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)	
SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications
TILE COUNCIL OF AMERICA (TCA)	
TCA Hdbk	(2007) Handbook for Ceramic Tile Installation
U.S. GREEN BUILDING COUNCIL (USGBC)	
LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building

Rating System for New Construction (LEED-NC)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Drawings showing ceramic tile pattern elevations, floor plans.

SD-03 Product Data

Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data
Tile
Setting-Bed
Mortar, Grout, and Adhesive; (LEED)

Manufacturer's catalog data and preprinted installation and cleaning instructions. Indicate VOC content.

Tile; (LEED)
Reinforcing Wire Fabric; (LEED)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

SD-04 Samples

Tile
Accessories
Marble Thresholds
Grout

Samples of sufficient size to show color range, pattern, type and joints.

SD-06 Test Reports

Testing

Copy of results for electrical resistance tests.

SD-07 Certificates

Tile
Mortar, Grout, and Adhesive

Certificates indicating conformance with specified requirements. Furnish a master grade certificate for tile.

SD-11 Closeout Submittals

Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Tile; (LEED)

Reinforcing Wire Fabric; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives; (LEED)

LEED documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 DELIVERY AND STORAGE

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and stored under cover in accordance with manufacturer's printed instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

a. Close space in which tile is being set to traffic and other work. Keep closed until tile is firmly set. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer.

b. Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.5 SUSTAINABLE DESIGN REQUIREMENTS

1.5.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Tile materials may be locally available.

1.5.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.7 EXTRA STOCK

Supply an extra two percent of each type tile used in clean and marked cartons.

1.8 DETAIL DRAWINGS

Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface.

PART 2 PRODUCTS

2.1 TILE

As indicated. Conform to TCA Hdbk for standard grade tile. Provide grade sealed containers. Mark seals with the marks on the signed master grade certificate. Provide an impact resistant tile with a minimum floor breaking strength for wall tile of 90 pound and for floor tile of 250 pound in accordance with ASTM C 648. The manufacturer will provide a frost resistant rating for tile used in cold climate projects as determined by ASTM C 1026. Provide a 0.50 maximum percent water absorption in accordance with ASTM C 373. Provide a minimum coefficient of friction of 0.50, 0.60 wet and dry in accordance with ASTM C 1028. Identify floor tile as Class III-Medium Heavy, IV Plus-Extra Heavy, Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic. Coordinate the color with Section 09 06 90 COLOR SCHEDULE. Tile shall contain a minimum of 5, 10 percent post-consumer recycled content, or a minimum of 20, 40 percent post-industrial recycled content, unless specified otherwise. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Tile may contain post-consumer or post-industrial recycled content.

2.1.1 Mosaic Tile

Furnish ceramic-free recycled glass mosaic tile, minimum 85 percent post-consumer recycled glass, Glass-bonded ceramic mosaic tile, minimum 55 percent post-consumer recycled glass, ceramic mosaic tile and trim shall be

unglazed natural clay, conductive with cushion edges, porcelain containing a minimum of 70 percent post-industrial feldspar, unpolished, polished, with sharply formed face. Provide tile size 1 by 1 inch, 1 by 2 inch, 2 by 2 inch, a mixture of standard sizes in a stock pattern. Coordinate color with Section 09 06 90 COLOR SCHEDULE as indicated.

2.1.2 Quarry Tile

Furnish an unglazed quarry tile and trim with smooth surface, abrasive surface. Quarry tile shall contain a minimum of 17 percent post-industrial recycled content. Use 6 by 6 by 1/2 inch. Coordinate color with Section 09 06 90 COLOR SCHEDULE as indicated.

2.1.3 Paver Tile

Furnish 4 by 4 by 3/8 inch, 6 by 6 by 3/8 inch, 4 by 8 by 3/8 inch size paver tile made of low-fire clay, glazed with lead-free glaze, unglazed. Coordinate color with Section 09 06 90 COLOR SCHEDULE as indicated.

2.1.4 Detectable Warning Tile

Furnish an unglazed detectable warning tile with raised truncated domes with a diameter of nominal 0.9 inch at a height of nominal 0.2 inch and a center-to-center spacing of nominal 2.35 inch that contrast visually with adjoining surfaces. Provide 6 by 6 by 1/2 inch tile. Coordinate color with Section 09 06 90 COLOR SCHEDULE as indicated.

2.1.5 Porcelain Tile

Furnish an unglazed porcelain tile and trim with the color extending uniformly through the body of the tile. Porcelain tile shall contain a minimum of 70 percent post-industrial feldspar, recycled content. Provide a nominal size of 12 by 12 by 5/16 inch thick. Criteria for tile to meet or exceed is as follows: Abrasive wear in accordance with ASTM C 501 and bonding strength in accordance with ASTM C 482. Comply with 36 CFR 1191 for coefficient of friction for interior tiled floors. Coordinate color with Section 09 06 90 COLOR SCHEDULE as indicated.

2.1.6 Glazed Wall Tile

Provide glazed wall tile with cushioned edges and trim edged with lead-free bright, matte finish. Provide tile 4-1/4 by 4-1/4, 4-1/4 by 6, 6 by 6 inch. Coordinate color with Section 09 06 90 COLOR SCHEDULE as indicated.

2.1.7 Stone Tile Stone Chip Tile

Tile shall be _____ by _____ inches. Color shall be in accordance with Section 09 06 90 COLOR SCHEDULE as indicated.

2.1.8 Accessories

Provide built-in type accessories of the same materials and finish as the wall tile. Provide accessories as follows:

	Quantity	Location
a. Recessed soap holders	_____	_____
b. Tumbler holders	_____	_____

c. Combination tumbler and toothbrush holders	_____	_____
d. Towel bars, stainless steel, ceramic 24, 30 inch long, two towel posts	_____	_____
e. Robe hooks	_____	_____
f. Roll paper holder	_____	_____
g. Recessed soap holder and hand hold combination: support static load in compliance with ASTM F 446	_____	_____

2.2 SETTING-BED

Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C 33 for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C 150 for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C 144 for sand.

2.2.4 Hydrated Lime

Conform to ASTM C 206 for hydrated lime, Type S or ASTM C 207, Type S.

2.2.5 Metal Lath

Conform to ASTM C 847 for flat expanded type metal lath, and weighing a minimum 2.5 pound/square yard.

2.2.6 Reinforcing Wire Fabric

Conform to ASTM A 185/A 185M for wire fabric. Provide 2 by 2 inch mesh, 16/16 wire, or 1-1/2 by 2 inch mesh, 16/13 wire. Wire fabric shall be manufactured from a minimum of 80 percent recycled post-consumer waste and a minimum of 10 percent recycled post-industrial waste. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Wire fabric may contain post-consumer or post-industrial recycled content.

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

Interior adhesives, sealants, primers and sealants used as filler must meet the requirements of LEED low emitting materials credit. Conform to SCAQMD Rule 1168, and to the following for mortar, grout, adhesive, and sealant:

2.4.1 Dry-Set Portland Cement Mortar

TCA Hdbk. Zero-volatile organic compound (VOC) content.

2.4.2 Conductive Dry-Set Mortar

TCA Hdbk. Zero-VOC content.

2.4.3 Latex-Portland Cement Mortar

TCA Hdbk. Zero-VOC content.

2.4.4 Ceramic Tile Grout

TCA Hdbk; petroleum-free and plastic-free sand portland cement grout, dry-set grout, latex-portland cement grout, commercial portland cement grout. Maximum VOC content of 150 grams/liter.

2.4.5 Organic Adhesive

TCA Hdbk, Type I. Water-resistant. Comply with applicable regulations regarding toxic and hazardous materials, GS-36, and as specified. Tile adhesive shall have a maximum VOC content of 65, 44 grams/liter.

2.4.6 Epoxy Resin Grout

TCA Hdbk. Prohibited unless specifically indicated otherwise.

2.4.7 Furan Resin Grout

TCA Hdbk and consist of an intimate mixture of furfuryl-alcohol resin with carbon filler and catalyst. Prohibited unless specifically indicated otherwise.

2.4.8 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Single-component polyurethane sealant shall have a zero-VOC content. Two-component polyurethane sealant shall have a maximum VOC content of 45 grams/liter.

2.4.9 Cementitious Backer Board

Provide cementitious backer units, for use as tile substrate over wood sub-floors, in accordance with TCA Hdbk. Furnish 1/4, 1/2 inch thick cementitious backer units.

2.4.10 Glass Mat Gypsum Backer Panel

Provide glass mat water-resistant gypsum backer board, for use as tile substrate over wood subfloors, in accordance with ASTM C 1178/C 1178M. Provide 1/4, 1/2 inch thick glass mat gypsum backer board.

2.5 MARBLE THRESHOLDS

Provide marble thresholds of size required by drawings or conditions. Categorize marble Group A as classified by MIA Design Manual. Provide a fine sand-rubbed finish marble with white, pink, or gray in color as approved by the Contracting Officer. Provide minimum 12.0 marble abrasion when tested in accordance with ASTM C 241.

2.6 MEMBRANE MATERIALS

Conform to ASTM D 226, Type 1 for 15 pound waterproofing membrane, asphalt-saturated building felt. Conform to ASTM D 2103, ASTM D 4068, 4 mil for polyethylene film.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex Portland Cement Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCA Hdbk, method _____.

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 4 mil polyethylene membrane, metal lath, and scratch coat. Conform to TCA Hdbk for workable mortar bed, materials, and installation of tile. Conform to TCA Hdbk for cured mortar bed and materials.

3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Use Dry-set or Latex-Portland Cement to install tile in accordance with

TCA Hdbk. Use Latex Portland Cement when installing porcelain ceramic tile.

3.3.3 Organic Adhesive

Conform to TCA Hdbk for the organic adhesive installation of ceramic tile.

3.3.4 Furan Mortar and Grout

Conform to TCA Hdbk for furan mortar and grout installation.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCA Hdbk method _____. Install shower receptors in accordance with TCA Hdbk method B414, B415.

3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCA Hdbk for workable mortar bed materials and installation. Conform to TCA Hdbk for cured mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

3.4.2 Dry-Set and Latex-Portland Cement

Use dry-set or Latex-Portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCA Hdbk. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Resinous Grout

When resinous grout is indicated, grout quarry tile with either furan or epoxy resin grout. Rake and clean joints to the full depth of the tile and neutralize when recommended by the resin manufacturer. Install epoxy resin grout in conformance with TCA Hdbk. Install resin grout in accordance with manufacturer's printed installation instructions. Provide a coating of wax applied from the manufacturer on all tile installed and furan resin. Follow manufacturer's printed installation instructions of installed resin grout for proportioning, mixing, installing, and curing. Maintain the recommended temperature in the area and on the surface to be grouted. Protect finished grout of grout stain.

3.4.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCA Hdbk.

3.4.5 Waterproofing

Shower pans are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Conform to the requirements of Section 07 12 00 BUILT-UP BITUMINOUS WATERPROOFING for waterproofing under concrete fill.

3.4.6 Concrete Fill

Provide a 3500 psi concrete fill mix to dry as consistency as practicable. Compose concrete fill by volume of 1 part Portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mix with water to as dry a consistency as practicable. Spread, tamp, and screed concrete fill to a true plane, and pitch to drains or levels as shown. Thoroughly damp

concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 2 inch. Tie laps together with 18 gauge wire every 10 inch along the finished edges and every 6 inch along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance between the under-floor surface and the finished tiles floor surface is a minimum2 inch, and of the same thickness that the mortar setting-bed over the concrete fill with the thickness required in the specified TCA Hdbk method.

3.5 INSTALLATION OF CONDUCTIVE FLOORING

Install conductive ceramic mosaic tile floors in accordance with TCA Hdbk.

3.6 INSTALLATION OF MARBLE THRESHOLDS

Install thresholds where indicated, in a manner similar to that of the ceramic tile floor. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

3.7 TESTING

Perform electrical resistance tests on conductive flooring, in the presence of the Contracting Officer, by a technician experienced in such work. Furnish a copy of the test results. Provide test procedures, testing apparatus, and test results in accordance with the provisions for Conductive Flooring in NFPA 99.

3.8 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00JOINT SEALANTS.

3.8.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.8.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

3.9 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall

surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

3.10 WASTE MANAGEMENT

Separate waste, including metal and cardboard, in accordance with the Waste Management Plan and recycle or reuse. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in designated containers and areas. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in designated containers and areas and dispose of properly. Set aside and protect half-tile and larger offcuts and remainders for reuse by the Government. Crush broken tile, offcuts smaller than a half tile, and excess mortar and grout for use as mosaic, sub-base, or fill. Identify manufacturer's policy for collection or return of construction scrap, unused material, demolition scrap, and packaging material. Institute recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials.

-- End of Section --

SECTION 09 51 00

ACOUSTICAL CEILINGS

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1008/A 1008M	(2007a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 489	(2004; R 2006) Standard Specification for Carbon Steel Lifting Eyes
ASTM A 580/A 580M	(2006) Standard Specification for Stainless Steel Wire
ASTM A 641/A 641M	(2003) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(2007) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 423	(2007a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635/C 635M	(2007) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636/C 636M	(2006) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels

ASTM C 834	(2005) Latex Sealants
ASTM E 119	(2007a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1264	(1998; R 2005) Acoustical Ceiling Products
ASTM E 1477	(1998a; R 2003) Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
ASTM E 580/E 580M	(2006) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 795	(2005) Mounting Test Specimens During Sound Absorption Tests
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2007) Fire Resistance Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

SD-03 Product Data

Acoustical Ceiling Systems

a. Manufacturer's data indicating percentage of recycle material in acoustic ceiling tiles to verify affirmative procurement compliance.

b. Total weight and volume quantities of acoustic ceiling tiles with recycle material.

c. Manufacturer's catalog for the following items showing UL classification of fire-rated ceilings giving materials, construction details, types of floor and roof constructions to be protected, and UL design number and fire protection time rating

for each required floor or roof construction and acoustic ceiling assembly.

SD-04 Samples

Acoustical Units
Acoustic Ceiling Tiles

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

SD-06 Test Reports

Fire Resistive Ceilings
Ceiling Attenuation Class and Test

Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified fire endurance and sound transmission requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resistance may be submitted in lieu of test reports.

SD-07 Certificates

Acoustical Units
Acoustic Ceiling Tiles

Certificate attesting that the mineral based acoustical units furnished for the project contain recycled material and showing an estimated percent of such material.

1.3 GENERAL REQUIREMENTS

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. The unit size, texture, finish, and color must be as specified. . The location and extent of acoustical treatment must be as shown on the approved detail drawings. Coordinate with paragraph RECLAMATION PROCEDURES for reclamation of mineral fiber acoustical ceiling panels to be removed from the job site.

1.3.1 Fire Resistive Ceilings

Rate acoustical ceiling systems, indicated as fire resistant, for fire endurance as specified when tested in accordance with ASTM E 119. Suspended ceiling must have been tested with a specimen roof, floor assembly representative of the indicated construction, including mechanical and electrical work within ceiling space openings for light fixtures, and air outlets, and access panels. Provide ceiling assembly rating for 1, 1-1/2, 2, 3, 4 hour concealed grid system, exposed grid system, as shown on drawings. Provide acoustical units with a flame spread of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E 84.

1.3.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C 423 Test Method.

1.3.3 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

1.4 DELIVERY AND STORAGE

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.6 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.8 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Conform acoustical units to ASTM E 1264, Class A, and the following requirements:

2.1.1 Affirmative Procurement

Mineral Wool, Cellulose, and Laminated Paperboard used in acoustic ceiling tiles are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/). EPA's recommended Recovered Materials Content Levels for Mineral Wool, Cellulose, Structural Fiberboard and Laminated Paperboard are:

Product	Material	Percent of Post Consumer Materials	Percent of Total Recovered Materials
Laminate Paperboard	Post Consumer Paper	100	100
Rock Wool	Slag	75	
Cellulose	Post Consumer Paper	75	75

a. The recommended recovered materials content levels are based on the weight (not volume) of materials in the insulating core only.

b. For informational purposes, a list of known sources for acoustical ceiling tiles using recycled material is provided in the EPA/CPG Supplier database at http://www.ergweb2.com/cpg4review/user/cpg_search.cfm.

c. Note that the Contractor is not limited to these sources. A product meeting CPG recycle requirements from other sources may be submitted for the Government's approval.

d. Submit recycled material content data for acoustic ceiling tiles indicating compliance with affirmative procurement.

e. Submit total weight and volume quantities of acoustic ceiling tiles with recycle material.

2.1.2 Units for Exposed-Grid System A

a. Type: As indicated. I (cellulose composition), III (non-asbestos mineral fiber with painted finish), IV (non-asbestos mineral fiber with membrane-faced overlay), IX (mineral fiber with scrubbable finish), X (mineral composition with plastic membrane), XI (mineral fiber with fabric faced overlay), XII (fiberglass base with membrane-faced overlay).

b. Flame Spread: Class A, 25 or less

c. Pattern: As indicated. A, B, C, D, E, F, G, I, J, K.

d. Minimum NRC: As indicated. 0.75 in open office areas; 0.60 in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; 0.50 in all other rooms and areas when tested on mounting Type E-400 of ASTM E 795.

e. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

f. Nominal size: 24 by 48 inch.

g. Edge detail: As indicated. Square, Reveal, Trimmed and butt as indicated.

h. Finish: Factory-applied standard finish, color finish.

i. Minimum CAC: 40.

2.1.3 Units for Concealed-Grid System A

a. Type: As indicated. I (cellulose composition), III (non-asbestos mineral fiber with painted finish), IV (non-asbestos mineral fiber with

membrane-faced overlay), IX (mineral fiber with scrubbable finish), X (mineral composition with plastic membrane), XI (mineral fiber with fabric faced overlay), XII (fiberglass base with membrane-faced overlay).

b. Flame Spread: Class A, 25 or less.

c. Pattern: As indicated. A, B, C, D, E, F, G, I, J, K.

d. Minimum NRC: 0.50 when tested on mounting Type B or Type E-400 of ASTM E 795.

e. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

f. Nominal size: 12 by 12 inch.

g. Edge detail: As indicated. beveled, square.

h. Joint detail: As indicated. kerfed and rabbeted, tongue and grooved.

i. Finish: As indicated. Factory-applied standard finish, color finish.

j. Minimum CAC: 40.

2.1.4 Metal Pans A

a. Type: As indicated. V, steel, VI, ASTM A 167 stainless steel, VII, aluminum, perforated pans with acoustical, non-asbestos, insulation backing.

b. Flame Spread: Class: A, 25 or less.

c. Pattern: As indicated. A, C, I.

d. Minimum NRC: 0.75 in open office areas; 0.60 in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; 0.50 in all other rooms and areas when tested on mounting Type E-400 of ASTM E 795.

e. Minimum Light Reflectance coefficient: LR-1, 0.75 or greater.

f. Nominal size: 24 by 24 inch.

g. Edge detail: Manufacturer's standard.

h. Joint detail: Beveled.

i. Finish: Factory-applied standard finish.

j. Pads: Completely enclosed, of material and thickness required for acoustical and fire test ratings.

2.1.5 Impact/Abrasion Resistant Units

a. Type: Non-asbestos mineral composition with a hardened mineral surface and factory applied white paint finish. Provide a surface resistant to impact and abrasion.

b. Flame Spread: Class: A, 25 or less.

c. Pattern: As indicated.

d. Minimum NRC: 0.50 when tested on Mounting Type E-400 of ASTM E 795.

e. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

f. Nominal Size: As indicated. 12 by 12, 24 by 24, 24 by 48 inch.

g. Edge Detail: As indicated. Square, Beveled.

h. Joint Detail: As indicated. Trimmed and butted, Kerfed and rabbeted.

2.1.6 Humidity Resistant Composition Units

a. Type: Non-asbestos mineral or glass fibers bonded with ceramic, moisture resistant thermo-setting resin, or other moisture resistant material and having a factory applied white paint finish. Provide panels that do not sag or warp under conditions of heat, high humidity or chemical fumes.

b. Flame Spread: Class: A, 25 or less.

c. Pattern: As indicated.

d. Minimum NRC: Minimum 0.50 when tested on Mounting Type E-400 of ASTM E 795.

e. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

f. Nominal Size: As indicated. 24 by 48 inch.

g. Edge Detail: Square.

2.1.7 Metal Faced Composition Units

a. Type V (Steel facings with non-asbestos mineral composition absorbent backing).

b. Type VI (Stainless steel facings with non-asbestos mineral composition absorbent backing)

c. Type VII (Aluminum facings with non-asbestos mineral composition absorbent backing) with anodized, baked enamel, acrylic finish color white, _____.

d. Flame Spread: Class: A, flame spread 25 or less.

e. Pattern: As indicated..

f. Minimum (NRC): 0.75 in open office areas. 0.60 in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated. 0.50 in all other rooms and areas. Base the tested NRC value on Mounting Type E-400 of ASTM E 795.

g. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

h. Nominal Size: 24 by 24, 48 inch.

i. Edge Detail: Square.

j. Joint Detail: Trimmed and butted.

2.1.8 Unit Acoustical Absorbers

Absorbers shall be individually mounted sound absorbing plaques composed of glass fibers or non-asbestos mineral fibers and having a NRC range of not less than 0.60 - 0.70 when tested in accordance with ASTM C 423 and reported as a 4 frequency average.

2.2 SUSPENSION SYSTEM

Provide standard, fire-resistive, snap-in metal pan, exposed-grid, indirect hung concealed H and T or Zee, direct hung, concealed, downward access, direct hung, concealed, upward access, standard width flange, narrow width flange, narrow width slotted flange as shown on drawings suspension system conforming to ASTM C 635/C 635M for intermediate-duty systems, for heavy-duty systems. Provide surfaces exposed to view of aluminum or steel with a factory-applied white, black, color baked-enamel finish, aluminum with a clear anodized finish, aluminum with colored factory-applied vinyl paint finish. Provide wall molding having a flange of not less than 15/16 inch. Provide inside and outside corner caps, standard, overlapped, mitered corners. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the guidance in UFC 3-310-04 and ASTM E 580/E 580M contract drawings.

2.3 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Conform wires to ASTM A 641/A 641M, Class 1, 0.11 inch in diameter. ASTM A 580/A 580M, composition 302 or 304, condition annealed stainless steel, 0.11 inch in diameter.

2.3.2 Straps

Provide straps of 1 by 3/16 inch galvanized steel conforming to ASTM A 653/A 653M, with a light commercial zinc coating or ASTM A 1008/A 1008Mwith an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

2.3.3 Rods

Provide 3/16 inch diameter threaded steel rods, zinc or cadmium coated.

2.3.4 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with ASTM A 489. Eyebolt size must be a minimum 1/4 inch, zinc coated, cadmium plated.

2.3.5 Masonry Anchorage Devices

Comply with ASTM C 636/C 636M for anchorage devices for eyebolts, machine screws, wood screws.

2.4 ACCESS PANELS

Provide access panels that match adjacent acoustical units, designed and equipped with suitable framing and fastenings for removal and replacement without damage. Size panel to be not less than 12 by 12 inch or more than 12 by 24 inch.

a. Attach an identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, near one corner on the face of each access panel.

b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. Provide plates or buttons of minimum 1 inch diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the Contracting Officer. Code identification system is as follows:

1 Fire detection/alarm system

2 Air conditioning controls

3 Plumbing system

4 Heating and steam systems

5 Air conditioning duct system

6 Sprinkler system

7 Intercommunication system

8 Nurse's call system

9 Pneumatic tube system

10 Medical piping system

11 Program entertainment

12 Telephone junction boxes

13 Detector X-ray

2.5 ADHESIVE

Use adhesive as recommended by tile manufacturer.

2.6 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.7 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as specified in Section 09 06 90 COLOR SCHEDULE as indicated.

2.8 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C 834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for uneveness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C 636/C 636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.1.5 Adhesive Application

Wipe back of tile to remove accumulated dust. Daub acoustical units on back side with four equal daubs of adhesive. Apply daubs near corners of tiles. Ensure that contact area of each daub is at least 2 inch diameter in final position. Press units into place, aligning joints and abutting units tight and uniform without differences in joint widths.

3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

3.4 RECLAMATION PROCEDURES

Neatly stack ceiling tile, designated for recycling by the Contracting Officer, on 4 by 4 foot pallets not higher than 4 foot. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

-- End of Section --

SECTION 09 64 66

WOOD ATHLETIC FLOORING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA M4	(2002) Standard for the Care of Preservative-Treated Wood Products

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM C 208	(1995; R 2001) Cellulosic Fiber Insulating Board
ASTM D 1622	(2003) Apparent Density of Rigid Cellular Plastics
ASTM D 2103	(2005) Standard Specification for Polyethylene Film and Sheeting
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 226	(2006) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 395	(2003) Standard Test Methods for Rubber Property - Compression Set
ASTM D 41	(2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 412	(2006a) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D 449	(2003) Asphalt Used in Dampproofing and Waterproofing
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM F 36	(1999; R 2003) Compressibility and Recovery of Gasket Materials

MAPLE FLOORING MANUFACTURERS ASSOCIATION (MFMA)

MFMA AFSFSCL	(2003) Athletic Floor Sealer and Finish Specifications and Conformance List #22
MFMA GRHM	(2000) Grading Rules for MFMA Northern Hardwood Maple
MFMA SSCLFMGF	(2000) Sanding, Sealing, Court Lining, Finishing and Resurfacing of Maple Gym Floors

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hardwood strip flooring system

Clearly delineate components of the system. Show layout of sleepers, steel channels, steel spines; location of anchor plate assemblies, floor outlets, and underfloor conduit or raceway location; flooring system details; and flooring abutting other construction. Accessories shall be approved by the flooring manufacturer.

SD-03 Product Data

Hardwood strip flooring components

SD-04 Samples

Strip flooring

Hardwood base

Molded-rubber base

Steel channels and clips

Fiberboard underlayment

Flexible foam underlayment

Cushions and pads

Corkboard or corkroll

Sleepers and nailers

SD-06 Test Reports

Preservative treatment

SD-08 Manufacturer's Instructions

Flooring system

Adhesive for membrane installation

Submit flooring system manufacturer's installation instructions. Submit vaporproofing manufacturer's written recommendations for adhesives to be used in membrane installation.

SD-10 Operation and Maintenance Data

Hardwood strip flooring, Data Package 1

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened packages, bundles, or containers. Protect materials against dampness during shipment and after delivery. Store material under cover in a well-ventilated building. Prevent exposure to extreme changes of temperature and humidity. Do not store materials in building under construction until wet-applied building materials are dry. Store flooring in accordance with MFMA GRHM, under adequate and controlled ventilation and under approved temperature and humidity conditions at the location where it is to be laid for at least 7 days before installation. Handle and store preservative-treated materials in accordance with AWPA M4.

1.4 ENVIRONMENTAL CONDITIONS

For at least one week prior to and during installation, in the location to receive finish flooring and the location where flooring will be stored, maintain a temperature of between 65 and 80 degrees F, and a relative humidity of between 40 and 60 percent. When the interior relative humidity exceeds 60 percent during or after installation of flooring, sanding and finishing of flooring shall be delayed for 2 to 3 weeks after completion of laying, unless directed otherwise. Provide adequate ventilation during the entire sealing and finishing process to ensure that no unhealthy or hazardous accumulation of vapors occurs. Ensure that environmental conditions are met.

PART 2 PRODUCTS

2.1 HARDWOOD STRIP FLOORING SYSTEMS ON CONCRETE SLAB

2.1.1 Clipped to Steel Channels on Underlayment

Provide flooring system consisting of hardwood strip flooring clipped to steel channels that rest in premilled grooves in fiberboard, flexible foam underlayment. Anchor steel channels to concrete floor slab.

2.1.2 Wood Sleepers with Rubber Cushions

Provide flooring system consisting of hardwood strip flooring nailed to wood sleepers that are seated on rubber cushions resting on the concrete floor slab.

2.1.3 Wood Board Subflooring, Wood Nailers, and Asphalt Fill

Provide flooring system consisting of hardwood strip flooring nailed to wood board subflooring that is, in turn, nailed to shimmed wood nailers anchored to the concrete floor slab. Provide hot asphalt fill under and between the wood nailers.

2.1.4 Plywood Subflooring with Rubber Pads

Provide flooring system consisting of hardwood strip flooring nailed to two-layer plywood subflooring that is seated on cushioned pads resting on the concrete floor slab.

2.1.5 Steel-Splined, Continuous Unit, on Cork Underlayment

Provide flooring system consisting of uniform lengths of hardwood strip flooring interlocked with steel splines and laid in asphalt mastic on cork underlayment which is laid in asphalt mastic over membrane of felt on the concrete floor slab.

2.2 MATERIALS

2.2.1 Strip Flooring

Second or better grade hard maple, beech or birch graded in accordance with current MFMA GRHM. Flooring shall be 33/32 inch thick by 1 1/2 inches or narrower on the face, kiln dried, continuous tongue-and-groove, and end-matched. Each bundle of flooring shall be clearly grade stamped. Moisture content of strip flooring shall not exceed 8 percent at time of arrival on job site and shall be allowed to acclimate in accordance with paragraph entitled "Delivery, Storage, and Handling." Flooring for steel-splined systems shall be edge-grain 33/32 inch thick by 1 5/16 inch on the face, kiln-dried, continuous tongue-and-groove, and end grooved.

2.2.2 Hardwood Base

Clear hard maple, beech or birch. Provide shape and size of base as indicated or as recommended by the flooring manufacturer.

2.2.3 Molded-Rubber Base

4 inch vertical leg by 3 inch, designed to allow ventilation under floor, and as recommended by flooring manufacturer.

2.2.4 Steel Angle Base

Provide 3 by 3 by 3/16 inch continuous steel angle along perimeter walls, designed to allow ventilation under the floor. Base angle shall conform to ASTM A 36/A 36M.

2.2.5 Steel Channels and Clips

Provide channels and clips not less than 16 gagezinc-coated steel.

2.2.6 Fiberboard Underlayment

ASTM C 208, fiberboard insulation board, impregnated with asphalt or coated with asphalt on faces and edges, treated for termite and water resistance.

2.2.7 Rubber Cushions and Pads

Rubber cushions and pads shall have a durometer hardness of A50, plus or minus 5, when tested in accordance with ASTM D 2240 and shall have a minimum tensile strength of 1500 psi, when tested in accordance with ASTM D 412. When subjected to an aging period of 70 hours and exposed to a temperature of 158 degrees F, allowed to cool to room temperature over a period of 4 hours and retested, tested specimen shall have a change in hardness of 10 points maximum, a change in tensile strength of minus 25 percent maximum and a change in ultimate elongation of minus 25 percent maximum in accordance with the applicable test methods referenced above. Test rubber cushions, under a load of 40 psi, in accordance with ASTM D 395, Method A. Size of tested specimen shall be 2 1/4 by 3 by 3/8 inch. Length of testing time shall be 22 hours; temperature of test shall be 158 degrees F. Test specimen shall recover, without set or displacement.

2.2.8 Flexible Foam Underlayment

Multicellular, closed cell flexible polyethylene plastic foam having smooth skin; density 1.7 to 3.3 pounds per cubic footwhen tested by ASTM D 1622. Foam shall be 1/2 inch thick by 48 inches wide by manufacturer's standard length, premilled to receive steel channels at 12 inch centers.

2.2.9 Polyethylene Vaporproofing Membrane

ASTM D 2103 Type 21110. Minimum thickness shall be 6 mils. Perm rating shall not exceed 0.02 when tested in accordance with ASTM E 96/E 96M.

2.2.10 Asphalt Primer

ASTM D 41.

2.2.11 Asphalt Mastic

As recommended by the flooring manufacturer.

2.2.12 Asphalt Fill

ASTM D 449, Type I.

2.2.13 Felt

ASTM D 226, type I, asphalt-saturated organic felt.

2.2.14 Building Paper

Water-vapor permeable, 20 lb per in. dry tensile strength.

2.2.15 Sleepers and Nailers

Surfaced on four sides, 2 by 3 inches nominal size, Standard or No. 2 grade douglas fir, northern or western and west coast hemlock, engleman-spruce or No. 2 dimension southern pine. Moisture content shall not exceed 15

percent. Provide preservative treatment in accordance with AWPA C1, AWPA C2. Identify treatment on each piece of material by the quality mark of an agency accredited by the Board of Review of the American Lumber Standard Committee. Brush coat exposed areas that are cut or drilled after treatment with the same preservative in accordance with AWPA M4.

2.2.16 Wood Board Subflooring

No. 2 common douglas fir, northern or western hemlock, englemann spruce, or southern pine No. 2 boards, northern red or Norway pine, surfaced on four sides. Nominal sizes shall be one by 6 inches or one by 4 inches. Moisture content shall not exceed 15 percent.

2.2.17 Plywood Subflooring

Douglas fir, southern pine, or western larch plywood; grade C-D, with exterior glue; 1/2 inch thick by 4 by 8 feet.

2.2.18 Sealing and Finishing for Hardwood Strip Flooring

Conform to MFMA AFSFSCL, Group II, III finish. Seal coat and finish coat materials shall be compatible with each other.

2.2.19 Game Line Marking Materials

As recommended by wood flooring finish manufacturer.

2.2.20 Nails

Shape and size as recommended by flooring manufacturer.

2.2.21 Underlayment

Corkboard or corkroll, 1/2 inch thick, conforming to ASTM F 36.

2.2.22 Adhesives

Waterproof, suitable for use with molded rubber base, recommended by rubber base manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Condition of Subfloors

Do not install flooring on surfaces that are not suitable for proper installation. Before beginning work under this section, correct defects such as rough or scaling concrete, low spots, high spots, uneven surfaces, and repair damaged portions of concrete slabs. Concrete slabs shall be given a leveling course of latex fill and the surface shall not vary more than 1/8 inch when measured with a 10 foot straightedge placed in any direction.

3.1.2 Preparation of Concrete Slab

Sweep concrete floor. Ensure that slab is dry and clean. Remove paint spots, plaster, masonry droppings, grease, dirt, and other foreign matter including chemical curing agents which may affect the bond of

adhesive-applied wood flooring systems. Concrete shall be fully cured and dry.

3.1.3 Anchor Plate Assemblies for Portable Sports Equipment

Floor anchor plate assemblies for vertically adjustable portable sports equipment shall be installed where indicated. Flooring shall be cut neatly around floor plates.

3.1.4 Work of Other Trades

Do not start work specified under this section until work of trades which could create moisture, has been completed.

3.1.5 Moisture Content

Check flooring, subflooring, sleepers and nailers with an approved meter verifying conformance with the requirements specified hereinbefore.

3.2 INSTALLATION

3.2.1 Vaporproofing For Slabs on Grade

Cover slab with the polyethylene membrane. Lap joints at least 6 inches. Seal joints with a full coverage of the adhesive recommended by the membrane manufacturer.

3.2.2 Flooring Clipped to Steel Channels

3.2.2.1 Channel Placing

Install each channel in premilled grooves spaced 12 incheson center in fiberboard, flexible foam parallel to the short side of the room, with butted end-to-end joints staggered at least 24 inches. Anchor channels to the slab at 14 inches on center with 3/8 inch diameter, flat headed anchors that penetrate the slab by at least 1 1/4 inches. Set channels level.

3.2.2.2 Laying of Finished Flooring

Lay finished flooring at right angles to the steel channels. Begin installation with double-tongue strips of flooring in center of room. Clip each board down tightly at each channel intersection with zinc-coated flooring clips. Each clip shall firmly engage the side edges of the flooring and the steel channels. Ensure that each clip is placed properly. Stagger adjacent end joints of flooring so that there will be at least two boards between joints. Where floor plates occur, install steel channels along edges of flooring board; provide clips for flooring. Drive each flooring strip up sideways and endways as tightly as practicable using steel driving tools that prevent marring of exposed flooring. Boards shall be scribed to permanent obstructions and securely blocked at wall lines.

3.2.3 Flooring on Wood Sleepers with Rubber Cushions

3.2.3.1 Installation of Wood Sleepers With Rubber Cushions

Install rubber-cushioned wood sleepers, 12 inches on center for 33/32 inch, 9 inches on center for 25/32 inch thick flooring, parallel to short side of the room, with butted end-to-end joints, 1/4 inch apart at the joints, staggered at least 24 inches. Sleepers shall have the rubber cushions

attached at 12 inch centers. Provide a 2 inch air space between ends and sides of sleepers at walls and other permanent obstructions. Sleepers shall be seated level and firm with rubber cushions bearing completely on the subfloor. In areas where fixed or temporary seats are indicated, provide 1 5/8 by 1 7/8 inch wood screeds midway between the cushioned wood sleepers.

3.2.3.2 Laying of Finished Flooring

Begin installation of flooring in center of space with double-tongue strips of flooring. Lay flooring at right angles to the wood sleepers. Blind nail each strip of flooring to each wood sleeper with 8 penny spiral screw nails. Leave a continuous air space, 2 inches wide, between the finished flooring and perimeter walls and other permanent obstructions. Stagger end joints of adjacent strips of flooring so that there will be at least two boards between each joint.

3.2.4 Flooring on Board Subflooring, Wood Nailers, and Asphalt Fill

3.2.4.1 Priming of Concrete Slab

Prime slab with asphalt primer using minimum of one gallon per 250 square feet. Allow primer to dry.

3.2.4.2 Wood Nailers

Install continuous 2 by 3 inch nominal size wood nailers 12 inches on center, parallel to short side of room, with butted end-to-end staggered joints, 1/4 inch apart at the joints. Elevate bottoms of nailers about 3/16 inch above concrete slab with fiber shims. Fasten nailers to slab with 1/4 by 3 1/2 inch power driven anchors spaced 30 inches on center and staggered in adjacent rows. Provide an additional anchor not more than 6 inches from the end of each nailer. Provide a 2 inch air space between ends and sides of sleepers at walls and other permanent obstructions. Nailers shall be set level and in alignment. Check level of tops of nailers with a surveyor's instrument.

3.2.4.3 Asphalt Fill

When the wood nailers have been set and leveled, pour the hot asphalt over the entire concrete slab surface; fill the spaces under the wood nailers completely and cover the concrete slab surface between the nailers to a depth of approximately 3/8 to 1/2 inch. Pour asphalt up 1/4 inch on the sides of the nailers.

3.2.4.4 Wood Board Subflooring

Apply wood subflooring diagonally over the wood nailers. Cut ends parallel to and over center lines of wood nailers. Nail subflooring securely to each wood nailer with 7 penny steel spiral screw nails; use two nails for 4 and 6 inch wide boards. Space boards approximately 1/8 inch apart. Top of subflooring shall have a true, even plane. Provide 2 inches of clearance between subflooring and perimeter walls and other permanent obstructions.

3.2.4.5 Felt

Cover wood subflooring with a layer of the felt. Butt edges tightly. Do not extend felt over air space between ends and sides of finished floor and perimeter walls or other permanent obstructions.

3.2.4.6 Laying of Finished Flooring

Begin installation of flooring in center of space with double-tongue strips of flooring. Lay flooring at right angles to the wood nailers and parallel with the long dimension of the room. Blind nail each strip of flooring through the subflooring and into the sleeper with 8 pennyscrew type nails, spaced not over 12 inches apart over the sleepers. Leave a continuous air space 2 inches wide between the finished flooring and perimeter walls and other permanent obstructions. Stagger end joints of adjacent strips of flooring so that there will be at least two boards between each joint.

3.2.5 Flooring on Plywood Subflooring With Rubber Pads

3.2.5.1 Installation of Plywood Subflooring With Rubber Pads

Provide two layers of 1/2 inch thick plywood sheets, of 4 by 8 feet. Each 4 by 8 foot sheet in the bottom layer bearing on slab shall have 32 rubber pads, 2 1/4 by 3 by 3/8 inch thick, approximately 12 inches on center in each direction, stapled to underside of sheet. Partial sheets shall have rubber pads 12 inches on center and at perimeters. Lay first layer of plywood on concrete floor slab, parallel to short side of room. Lay second layer at a 45 degree angle to first layer and fasten it to first layer by machine nailing or stapling on 24 inch centers using one inchnails or staples. Leave a continuous air space 2 inches wide between the subflooring and perimeter walls and other permanent obstructions and 1/4 inch between panels at sides and ends. Lap panels so that no joint will fall over any joint of the first layer. In areas where fixed or temporary seats are indicated, provide fixed hardboard shims, 1/8 inch thick, between the cushioned pads.

3.2.5.2 Laying of Finished Flooring

Begin installation of flooring in center of space with double-tongue strips of flooring. Lay flooring parallel with the long dimension of the room. Flooring shall be blind nailed on 10 inch centers with 1 3/4 inch spiral screw nails. Leave a continuous air space, 2 inches wide, between the finished flooring and perimeter walls and other permanent obstructions. Stagger end joints of adjacent strips of flooring so that there will be at least two boards between each joint. Roller skating rink flooring shall be 33/32 inch thick or 25/32 inch and laid in special octagonal pattern as indicated. Diagonal intersections of flooring shall be joined with barbed steel splines.

3.2.6 Flooring, Continuous Steel-Splined, on Cork Underlayment

3.2.6.1 Vaporproofing for Slabs on Grade

Prime concrete slab with asphalt primer using a minimum of one gallon per 250 square feet. Following application and drying of the primer apply a membrane of two layers of felt. Lay each layer of felt in a coating of trowelled asphalt mastic, applied at the rate of at least one gallon per 35 square feet. Felts shall be butted at joints. Turn up felt 1 1/2 inches at perimeter walls and other permanent obstructions. Roll felt thoroughly, eliminating air pockets and blisters, to provide an overall smooth and level surface. Cover top layer of felt with a coating of trowelled asphalt mastic applied at the rate of at least one gallon per 35 square feet.

3.2.6.2 Cork Underlayment

Install underlayment in asphalt mastic. Provide a 1/16 inchspace at joints of corkboard. After underlayment has been installed, roll entire area with a 150 pound roller to attain maximum bond and a uniformly even surface. Leave a 1 1/2 inch air space between underlayment and perimeter walls and other permanent obstructions.

3.2.6.3 Finished Flooring

Lay 12 inch long strips of finished flooring firmly in full bed of asphalt mastic in end-to-end courses, interlocking with saw-tooth steel splines into the slotted ends. Break joints of continuous strip units in succeeding courses. Lay continuous strip units parallel with the width of the room. Lay flooring level and in correct alignment. Leave a continuous air space, 1 1/2 inches wide, between the finished flooring and perimeter walls and other permanent obstructions. Lay flooring with hairline joints. Do not drive flooring up tightly.

3.2.7 Hardwood Base Installation

Install molded and perforated continuous hardwood base of the type indicated, along perimeter walls. Base shall have 3/8 inch diameter vent holes spaced 5 inches on center in a straight row. Nail or bolt base to wall. Do not fasten base to flooring.

3.2.8 Molded-Rubber Base Installation

Install molded-rubber base firmly on perimeter walls in continuous adhesive as recommended by the base manufacturer. Provide vertical, circular or semicircular vent holes in base spaced 5 inches on center in a straight row. Do not fasten base to flooring.

3.2.9 Steel Angle Base Installation

Install 3 by 3 by 3/16 inch continuous steel angle along perimeter walls. Bottom leg of angle shall have 3/8 inch diameter vent holes spaced 5 inches on center in a straight row. Fasten angle to wall at intervals of 16 inches with countersunk head expansion, toggle bolts. Do not fasten angle to flooring.

3.3 SANDING, FINISHING, AND MARKING

3.3.1 Sanding

Sand wood floor surfaces with a machine using coarse, medium, and fine grades of sandpaper; the edges shall be sanded to a smooth edge; the finished surface shall be smooth and level, free from scratches. A final disc sanding shall be provided. After final sanding or buffing, vacuum floors until clean. Do not walk on floors thereafter until finish has been applied and is dry.

3.3.2 Finishing

Finishing shall be provided as specified. Within one day after the final sanding, buffing, and sweeping have been completed, use a tacky rag to clean flooring with a solvent recommended by the manufacturer of the floor finish material. Follow cleaning with a coating of sealer; when thoroughly dry, burnish with No. 2 steel wool, using a power machine. After final

burnishing and prior to application of final finish coat(s), layout and mark game lines as specified herein; after game lines are thoroughly dry, apply final finish coat. Floors shall be wiped with a tacky rag each burnishing. Finish floors in accordance with MFMA SSCLFMGF. Four Coat Specification: Group II finish shall consist of one sealer coat and three finish coats. Group III finish shall consist of two sealer coats and two finish coats. Allow 5 days for proper curing.

3.3.3 Marking

Lay out game lines and fields and patterns where indicated, masking edges to provide sharp, clean edges. Edge shall be straight and width shall be uniform. Apply marking of colors indicated, providing a minimum dry film thickness of one mil.

3.4 PROTECTION

After completion of laying, finishing, and marking of the flooring, do not use the floor for at least 72 hours. Avoid heavy traffic on the floor for at least one week. Upon floor drying, use nonstaining, porous building paper of the type and grade recommended by manufacturer, taped along edges. Remove kraft paper covering after work in this area is completed.

-- End of Section --

SECTION 09 65 00

RESILIENT FLOORING

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4078	(2002) Water Emulsion Floor Polish
ASTM D 5603	(2001) Rubber Compounding Materials - Recycled Vulcanizate Particulate Rubber
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 648	(2006a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 1066	(2004) Standard Specification for Vinyl Composition Floor Tile
ASTM F 1303	(2004) Sheet Vinyl Floor Covering with Backing
ASTM F 1344	(2004) Rubber Floor Tile
ASTM F 1482	(2004) Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F 1700	(2004) Solid Vinyl Floor Tile
ASTM F 1859	(2004) Rubber Sheet Floor Covering Without Backing
ASTM F 1860	(2004) Rubber Sheet Floor Covering With Backing
ASTM F 1861	(2002) Resilient Wall Base
ASTM F 1869	(2004) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F 1913	(2004) Vinyl Sheet Floor Covering Without Backing

ASTM F 2034	(2003e1) Sheet Linoleum Floor Covering
ASTM F 2169	(2002) Resilient Stair Treads
ASTM F 2170	(2002) Determining Relative Humidity in Concrete Floor Slabs in situ Probes
ASTM F 710	(2005) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

GREEN SEAL (GS)

GS-36	(2000) Commercial Adhesives

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 FIRE RESISTANCE REQUIREMENTS

Provide a minimum average critical radiant flux of 0.22, 0.45 watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E 648.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Resilient Flooring and Accessories

Scaled drawings indicating patterns (including location of patterns and colors) and dimensions.

SD-03 Product Data

Resilient Flooring and Accessories

Manufacturer's descriptive data.

Adhesives; (LEED)

Manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics. Provide Material Safety Data Sheets (MSDS) for all primers and adhesives to the Contracting Officer. Highlight VOC emissions.

Vinyl Composition Tile; (LEED)
Sheet Vinyl Flooring; (LEED)
Rubber Tile; (LEED)
Rubber Sheet Flooring; (LEED)
Solid Vinyl Tile; (LEED)
Cement-Fiber Board; (LEED)

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

Sheet Linoleum
Linoleum Tile

Documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

Cork; (LEED)

Documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project. Documentation indicating relative dollar value of rapidly renewable materials to total dollar value of products included in project.

SD-04 Samples

Resilient Flooring and Accessories

Three samples of each indicated color and type of flooring, base, mouldings, and accessories. Provide a minimum 2-1/2 by 4 inch sample.

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests

Copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

SD-08 Manufacturer's Instructions

Surface Preparation
Installation

Manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Resilient Flooring and Accessories; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives; (LEED)

LEED documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Sheet Linoleum; (LEED)

Linoleum Tile; (LEED)

Cork; (LEED)

LEED documentation relative to rapidly renewable materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.4 DELIVERY AND STORAGE

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions, including _____. Do not store exposed rubber surface materials in occupied spaces. Do not store _____ near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. ee Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Flooring materials may be locally available.

1.6.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

1.7 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

1.9 EXTRA MATERIALS

Furnish extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles and 5 square feet for each 1000 square feet of sheet flooring installed. Furnish extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE TYPE A

Conform to ASTM F 1066 for vinyl-composition tile, Class 1, (solid color tile), Class 2, (through pattern tile), Composition 1, asbestos-free, 12 inch square and 3/32, 1/8 inch thick. Provide color and pattern uniformly distributed throughout the thickness of the tile. Tile shall contain a minimum of 90, 100 percent recycled material.

2.2 SHEET VINYL FLOORING TYPE A

Conform to ASTM F 1303 for sheet vinyl flooring, Type I, Grade 1, Class A-non-asbestos formulated fibrous backing or Class B-nonfoamed plastic backing (minimum wear layer thickness 0.020 inch and minimum overall thickness 0.080 inch) and a minimum 6 feet, 12 feet wide. ASTM F 1303, Type II, Grade 1, without backing (minimum wear layer thickness 0.080 inch and minimum overall thickness 0.080 inch), and a minimum 6 feet wide. Extend color and pattern through the total thickness of the material. ASTM F 1303, Type II, Grade 1, Class A non-asbestos formulated fibrous backing or Class B nonfoamed plastic backing (minimum wear layer thickness 0.050 inch and minimum overall thickness 0.080 inch) and a minimum 6 feet wide. Extend color and pattern throughout the thickness of the wearlayer. ASTM F 1913, (minimum wear layer thickness 0.075 inch and minimum overall thickness 0.075 inch) and a minimum 6 feet wide. Extend color and pattern through the total thickness of the material. Flooring shall contain 100 percent post-industrial recycled PVC plastic. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Sheet vinyl flooring may contain post-consumer or post-industrial recycled content. As required, provide welding rods as recommended by the manufacturer for heat welding of joints.

2.3 RUBBER TILE TYPE A

Conform to ASTM F 1344 for rubber tile Class 1 homogeneous, Class 2 layered, Type A (solid color) Type B (through mottled), 24 inch square. Provide smooth raised, round, square, diamond surface studs with chamfered edges. Provide high, low stud profile. Provide 0.125 inch overall thickness. Rubber tile shall contain a minimum of 90 percent post-consumer recycled material. With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D 5603, fine mesh size particulate, as indicated.

2.4 RUBBER SHEET FLOORING TYPE A

Conform to ASTM F 1859 for rubber sheet flooring (flooring without backing), Type I homogeneous, Type II layered or ASTM F 1860 (flooring with backing), Type I homogeneous, Type II layered, minimum, 36 inch wide. Provide smooth, embossed surface. Provide 0.080, 0.100, 0.118 inch overall thickness. Rubber sheet flooring shall contain a minimum of 90, 100 percent post-consumer recycled material. With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D 5603, fine mesh size particulate, Grade 1, 2, or 3, Grade 4, Grade 5, Grade 6. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Rubber sheet flooring may contain post-consumer or post-industrial recycled content.

2.5 SOLID VINYL TILE TYPE A

Conform to ASTM F 1700 for solid vinyl tile Class I monolithic (minimum wear layer thickness 0.125 inch and minimum overall thickness 0.125 inch, Class III printed film (minimum wear layer thickness 0.020 inch and minimum overall thickness 0.125 inch), Type A (smooth), B (embossed). Provide 12, 16, 18, 24, 36 inch, as indicated, square tile. Tile shall contain a minimum of 90, 100 percent recycled content.

2.6 SHEET LINOLEUM TYPE A

Conform to ASTM F 2034 for linoleum consisting of a homogeneous layer of a

mixture of linoleum cement (binder in linoleum consisting of a mixture of linseed oil, pine rosin, fossil, or other resins or rosins, or an equivalent oxidized oleoresinous binder), cork and/or wood flour, mineral fillers, and pigments bonded to a jute backing. Provide a minimum 6 feet wide and overall thickness not less than 0.080 inch, 0.100 inch, 0.125 inch for linoleum. Provide welding rods as recommended by the manufacturer for heat welding of joints.

2.7 WALL BASE

Conform to ASTM F 1861 for wall base, Type TS (vulcanized thermoset rubber) or Type TP (thermoplastic rubber), or Type TV (thermoplastic vinyl), Style A (straight - installed with carpet), and Style B (coved - installed with resilient flooring), and Style C (butt toe cove installed with 1/8 inch thick flooring). Provide 4, 6 inch high and a minimum 1/8 inch thick wall base. Furnish preformed, job formed corners in matching height, shape, and color. Rubber shall contain a minimum of 90 percent post-consumer recycled material. With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D 5603, fine mesh size particulate, Grade 1, 2, or 3, Grade 4, Grade 5, Grade 6. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Rubber sheet flooring may contain post-consumer or post-industrial recycled content.

2.8 INTEGRAL COVE BASE

Extend integral coved base for sheet vinyl and sheet linoleum flooring up the wall 4 inch. Provide a vinyl or rubber, clear anodized aluminum, square, round cap strip and vinyl, rubber, or wood fillet strip with a minimum radius of 3/4 inch for integral coved bases at perimeter and fixed vertical interruptions to flooring, as shown. Provide integral cove of the same material as flooring. Provide inside and outside corner protectors of ___-colored anodized aluminum, clear anodized aluminum or plastic approved by flooring manufacturer.

2.9 STAIR TREADS, RISERS, AND STRINGERS

Conform to ASTM F 2169 for treads, risers, and stringers Type TS (vulcanized thermoset rubber) or Type TP (thermoplastic rubber), or Type TV (thermoplastic vinyl). Rubber shall contain a minimum of 90 percent post-consumer recycled material. With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D 5603, fine mesh size particulate, Grade 1, 2, or 3, Grade 4, Grade 5, Grade 6. Vinyl shall contain 100 percent post-industrial recycled PVC plastic. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Rubber, Vinyl may contain post-consumer or post-industrial recycled content. Conform to ASTM F 2169 for surface of treads Class 1 smooth, Class 2 raised round, square, diamond stud, ribbed, pattern and have Group 1 abrasive non-slip strip, Group 2 strip for visually impaired of contrasting as indicated color of same, abrasive material. Provide square or round nosing. Provide either a one piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser.

2.10 FEATURE STRIP

Provide feature strips with vinyl composition tile and conform to ASTM F 1066, Class 1, (solid color tile), rubber tile and conform to ASTM F 1344 Class 1 homogeneous and be 1 inch wide, and of thickness to match the flooring.

2.11 MOULDING

Provide tapered mouldings of vinyl or rubber as indicated-colored anodized aluminum, clear anodized aluminum and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.12 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. Interior adhesives must meet the requirements of LEED low emitting materials credit. VOC content must be less than 50 grams/L, the current VOC content limits of GS-36 and SCAQMD Rule 1168.

2.13 SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions. Comply with ASTM F 1482 for panel type underlayment products. Use one of the following substrates:

a. Particleboard: As specified in Section 06 10 00 ROUGH CARPENTRY.

b. Fiberboard: As specified in Section 06 10 00 ROUGH CARPENTRY.

c. Cork: As specified in Section 06 10 00 ROUGH CARPENTRY

d. Plywood: As specified in Section 06 10 00 ROUGH CARPENTRY.

e. Concrete.

2.14 POLISH/FINISH

Furnish polish as recommended by the manufacturer and conform to ASTM D 4078.

2.15 CAULKING AND SEALANTS

Furnish caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.16 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

As indicated. Provide color, pattern and texture for resilient flooring and accessories in accordance with Section 09 06 90 COLOR SCHEDULE, as indicated on the drawings, selected from manufacturer's standard colors. Color listed is not intended to limit the selection of equal colors from other manufacturers. Provide floor patterns as specified. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern.

PART 3 EXECUTION

3.1 EXAMINATION/VERIFICATION OF CONDITIONS

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation.

Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Flatten floor to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F 710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Insstall underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. Comply with ASTM F 1482 for panel type underlayments. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove from the slabs concrete curing and sealer compounds, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxers, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests and comply with manufacturer's recommendations. Conduct moisture testing in accordance with ASTM F 1869 or ASTM F 2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations.

3.4 PLACING VINYL-COMPOSITION, LINOLEUM AND SOLID VINYL TILES

Install tile flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, but no edge tile with less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.5 PLACING SHEET VINYL FLOORING

Install sheet vinyl flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and

scribe flooring to walls and partitions after field flooring has been applied. Provide seams and edges of sheet vinyl flooring shown on the drawings, chemically bonded or heat welded in accordance with the manufacturer's written installation instructions. Finish joints flush, free from voids, recesses, and raised areas. Install flooring with an integral coved base.

3.6 PLACING SHEET LINOLEUM FLOORING

Install sheet linoleum flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied. Cut seams by overlapping or underscribing as recommended by the manufacturer. Provide seams of sheet linoleum flooring shown on the manufacturer's written installation instructions. Finish joints flush, free from voids, recesses, and raised areas. Install flooring with an integral coved base.

3.7 PLACING RUBBER TILE

Install rubber tile and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles, except where irregular-shaped rooms makes it impossible. Cut flooring to fit around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.

3.8 PLACING RUBBER SHEET FLOORING

Install rubber sheet flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut seams by overlapping or underscribing as recommended by the manufacturer. Lay out sheets to minimize waste. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.

3.9 PLACING FEATURE STRIPS

Install feature strips in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.10 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials.

When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions. Anchor aluminum moulding to floor surfaces as recommended by the manufacturer.

3.11 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.12 PLACING STAIR TREADS, RISERS, AND STRINGERS

Secure and install stair treads, risers, and stringers in accordance with manufacturer's printed installation instructions. Cover treads and risers to the full width of the stairs the surface of the stairs to within 6 inch of the edges. Provide stairs wider than manufacturer's standard lengths with equal length pieces butted together to cover the treads. Include stringer angles on both the wall and banister sides, and landing trim for installation.

3.13 PLACING INTEGRAL COVED BASE

Install integral cove base. Form integral base by extending the flooring material in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Form integral coved base by extending the flooring material 4, 6 inch onto the wall surface. Support cove by a filler. Provide a cap strip at the top of the base. Fill voids along the top edge of base at masonry walls with caulk.

3.14 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry/clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions. No sooner than 5 days after installation, wash flooring with a nonalkaline cleaning solution, rinsed thoroughly with clear cold water, and, except for rubber flooring and stair treads, risers and stringers, vinyl and other flooring not requiring polish by manufacturer, given the number of coats of polish in accordance with manufacturer's written instructions. Clean and maintain all other flooring as recommended by the manufacturer.

3.15 WASTE MANAGEMENT

Separate offcuts and waste materials and reuse or recycle in accordance with the Waste Management Plan, keeping sheet materials larger than 2 square feet and tiles larger than 1/2 tiles separate for reuse. Identify manufacturer's policy for collection or return of construction scrap, unused material, demolition scrap, and/or packaging material. Shred scrap cork and linoleum for composting on site. Place materials defined as hazardous or toxic waste in designated containers and dispose of properly. Close and seal tightly partly used sealant and adhesive containers and

store protected in a well ventilated fire-safe area at moderate temperature.

3.16 PROTECTION

From the time of laying until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

SECTION 09 65 66

RESILIENT ATHLETIC FLOORING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1054	(2002; R 2007) Rubber Property - Resilience Using a Rebound Pendulum
ASTM D 1242	(1995a) Resistance of Plastic Materials to Abrasion
ASTM D 1894	(2006) Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting
ASTM D 2240	(2005) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2632	(2001) Rubber Property-Resilience by Vertical Rebound
ASTM D 395	(2003) Standard Test Methods for Rubber Property - Compression Set
ASTM D 412	(2006a) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 624	(2000e1) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 1303	(2004) Sheet Vinyl Floor Covering with Backing
ASTM G 21	(1996; R 2002) Determining Resistance of Synthetic Polymeric Materials to Fungi

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

Drawings showing game lines, location of anchor plate assemblies, floor outlets, and under-floor conduit or raceways.

SD-03 Product Data

Installation

Manufacturer's descriptive data and catalog cuts indicating materials of construction and physical characteristics. Installation, cleaning and maintenance instructions shall be included.

SD-04 Samples

Flooring

Three samples minimum 9 x 11 inches of each color of flooring material required.

SD-07 Certificates

Materials

Manufacturer's certificates stating that the resilient athletic flooring materials conform to the specified requirements. Labels or markings affixed to manufacturer's products attesting that products meet requirements specified herein will be accepted in lieu of certificates.

1.3 QUALIFICATIONS

Adhesive applied and poured-in-place flooring shall be installed by an experienced floor applicator approved by the manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in manufacturer's original unopened containers with labels intact. Materials shall not be delivered to the installation area or installed before all work that may damage the materials or the finished floor, such as overhead work, is completed. Materials shall be stored in a clean, dry area. Materials in storage shall be maintained at temperatures recommended by the manufacturer. Protection boards shall be stored flat and off the ground.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.6 EXTRA MATERIALS

1.6.1 Floor Tiles

Spare tiles of each color shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

1.6.2 Carpeting

Extra material from same dye lot consisting of full width continuous broadloom shall be provided for maintenance. A minimum of _____ percent of total square yards of each carpet type, pattern, and color shall be provided.

PART 2 PRODUCTS

2.1 INDOOR-OUTDOOR CARPETING TYPE A

Carpet-type flooring shall be spike proof ribbed, berber pattern consisting of a top layer of rugged polypropylene or nylon fibers combined with an inorganic cut-resistant non-skid, wet areas artificial turf pattern consisting of a top layer of rugged polypropylene fibers combined with an inorganic cut-resistant, porous rubber knob, foam backing. Minimum total thickness shall be 0.375 inches. Finished surface pile yarn weight (face weight) shall be minimum _____ ounces/square yard. Test results for resistance to soil bacteria or fungi shall show no sustained growth or discoloration after 21 days when tested in accordance with ASTM G 21.

2.2 RUBBER COMPOSITION TILE TYPE A

Rubber tiles shall be interlocked (24 x 24 inches square, of solid first quality rubber, uniformly resilient material designed to be applied with, without adhesive. Tiles shall be approximately 1/2 inch thick, shall be smooth, traction texture, and shall be reversible, non-reversible. Flooring shall be able to withstand 75 percent compression for 22 hours at 158 degrees F without residual deformation when tested in accordance with ASTM D 395. Flooring shall have a durometer hardness Shore-A of 50-60 when tested in accordance with ASTM D 2240.

2.3 RUBBER POURED-IN-PLACE FLOORING TYPE A

The resilient poured-in-place rubber surface shall be composed of chloroprene rubber, chloroprene rubber sponge, aggregate, setting powders, and a top finish composed of acrylic resins. Flooring shall be able to withstand 50 percent compression for 72 hours at 72 degrees F with a residual deformation of less than 10 percent when tested in accordance with ASTM D 395. Flooring shall have a minimum compression modulus at 10 percent of 100 psi, a minimum elongation of 250 percent and a minimum tensile strength of 550 psi plus or minus 5 psi when tested in accordance with ASTM D 412. Flooring shall have a durometer hardness Shore-A of 55-60 when tested in accordance with ASTM D 2240 and a minimum tear resistance of 60 lbf/inch when tested in accordance with ASTM D 624.

2.4 SHEET RUBBER COMPOSITION FLOORING TYPE A

Sheet rubber flooring shall be prefabricated, homogeneous, natural and synthetic rubbers, and shall be minimum 3/16 inch thick, and shall have smooth gymnasium, textured all-purpose finish. Flooring shall be roll type not less than 60 inches wide. Flooring shall have a minimum tensile stress at 100 percent elongation of 220 psi and a minimum ultimate elongation of 250 percent when tested in accordance with ASTM D 412. Flooring shall be able to withstand 50 percent compression for 72 hours at 72 degrees F with a residual deformation of less than 10 percent when tested in accordance with ASTM D 395. Flooring shall provide a 55 plus or minus 5 percent rebound when tested in accordance with ASTM D 1054.

2.5 SHEET VINYL COMPOSITION FLOORING TYPE A

Sheet vinyl flooring shall consist of a solid polyvinyl chloride material which shall conform to the chemical resistance requirements of ASTM F 1303. Flooring shall be not less than 48 inches wide and shall have a minimum thickness of 1/8 inch. Floor surface shall be smooth, stipple, track embossed texture. Flooring shall have a minimum coefficient of friction of 0.75 when tested in accordance with ASTM D 1894. Flooring shall have an average thickness loss of 8.0 mils plus or minus 1 mil when tested in accordance with ASTM D 1242. Rebound resilience of flooring shall be greater than 12 percent and less than 30 percent when tested in accordance with ASTM D 2632. An optional compatible top coating shall be provided by the sheet vinyl flooring manufacturer.

2.6 URETHANE POURED-IN-PLACE FLOORING TYPE A

The resilient poured-in-place urethane surface shall be composed of a seamless pigmented monolithic material. Flooring shall be minimum 1/8 inch thick and shall have smooth gymnasium, textured all-purpose, textured track finish. Flooring shall have a durometer hardness Shore-A of 55-60 when tested in accordance with ASTM D 2240. Flooring shall have a minimum ultimate elongation of 250 percent when tested in accordance with ASTM D 412 and shall have a density of 1.25.

2.7 RESILIENT MAT UNDERLAY

Resilient mat underlay shall be prefabricated granulated indoor/outdoor rubber mat bound with polyurethane for shock absorption. Mat thickness shall be _____ inches.

2.8 ADHESIVES

Adhesive shall be as recommended by the flooring manufacturer and must correspond to the specified flooring product and to the substrate.

2.9 CRACK FILLER/LEVELER FOR CONCRETE SURFACES

Crack filler/leveler for concrete floor surfaces shall be as recommended by flooring manufacturer.

2.10 EDGING STRIPS

Strips shall be of the same material and design as recommended by flooring manufacturer.

2.11 PRIMER

Concrete primer shall be as recommended by flooring manufacturer and must correspond to the specified flooring product and to the substrate.

2.12 GAME LINE MATERIAL

Game line material shall as recommended by the flooring manufacturer and must correspond to the specified flooring product.

2.13 WALL BASE

Base shall be rubber, vinyl, Type straight, coved style. Base shall be 4

inches high and minimum 0.080 inch thick.

2.14 SEALANTS

Sealants shall be in accordance with Section 07 92 00 JOINT SEALANTS.

2.15 MANUFACTURERS COLOR

Color shall be in accordance with Section 09 06 90 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 PREPARATION

Concrete surfaces shall be completely cured and dry. No curing agents, sealers, or hardeners shall be used to aid in the curing of the concrete slab. Surfaces shall be free of paint spots, and other foreign materials. Surfaces shall be ground down or leveled with an approved leveling compound to a tolerance of plus or minus 1/8 inch within a 10 foot radius. Cracks, construction joints, or damaged portions of floor shall be filled with crack filler for concrete surfaces. Expansion joints shall be filled and sealed in accordance with the approved installation instructions of the manufacturer. All sealants shall be in accordance with ASTM C 920. Expansion joints shall not be filled with a material that will make them inoperable.

3.2 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

3.3 INSTALLATION

3.3.1 General Requirements

Installation shall be in accordance with the approved installation instructions. Tile or sheet flooring shall be rolled with a medium-sized roller in both directions to release entrapped air.

3.3.2 Molded Rubber Base

Base shall be installed in accordance with the approved installation instructions of the manufacturer of the base.

3.3.3 Indoor-Outdoor Carpeting

Application of flooring shall be as recommended by the manufacturer.

3.3.4 Sheet Vinyl Composition Flooring

Concrete slab shall be primed in accordance with approved installation instructions. Flooring shall be installed as recommended by the manufacturer.

3.3.4.1 Seams

End seams shall be cut and placed as recommended by the manufacturer. Seams shall be weighted as required.

3.3.4.2 Hot-welded Seams

Butted sheets shall be grooved to a depth of approximately two thirds of their total thickness using an electrical or hand grooving tool. Grooved seams shall be thermowelded using a hot air welding tool and a PVC welding thread. After seam has cooled to room temperature, the excess shall be trimmed off to provide a flush joint.

3.3.5 Sheet Rubber Composition Flooring

Sheet flooring shall be dry cut and layed out flat a minimum of 24 hours prior to adhering to the substrate. End seams shall be single cut. Edge seams shall be cut through overlapping sheets, then snapped into place to ensure tight seams. Seams shall be weighted as required.

3.3.6 Rubber Composition Tile Flooring

3.3.6.1 Application With Adhesive

Tiles shall be layed on adhesive surface in pattern according to approved detail drawings. Joints of tiles shall be even and tight. Tiles shall be cut to fit tightly against the wall.

3.3.6.2 Application Without Adhesive

Tiles shall be joined together using interlocking ears or other mechanical locking techniques. The ears shall interlock into the adjoining tile 1-1/2 inches and shall provide at least five interlocks for each 24 inch edge. Where required, a beveled transfer border shall be supplied to interlock with the flooring tiles. The borders shall be 6 inches wide and 24 inches long and the same thickness as the matching tiles.

3.3.7 Rubber Poured-in-Place Flooring

Concrete slab shall be primed with primer recommended by manufacturer in a thin film covering approximately 400 square feet per gallon. Chloroprene rubber shall be poured onto subfloor and troweled to a smooth and uniform layer of the required thickness. A grout chloroprene rubber coat shall be applied to fill possible voids in surface. After the chloroprene rubber is completely dry, a pigmented finish shall be applied with a spray and roller.

3.3.8 Urethane Poured-in-Place Flooring

Concrete slab shall be primed with primer recommended by the manufacturer. Rate of application shall be in accordance with approved installation instructions and shall be allowed to dry odor free. Concrete construction joints shall be covered with 2 inch wide PVC duct tape. Resin shall be applied in a minimum of 2 lifts. Pigmented and textured coatings shall be applied in accordance with manufacturer's recommendations.

3.3.9 Resilient Mat Underlay

The resilient mat underlay shall be unrolled and allowed to relax prior to cutting or fitting. Mat shall be installed in accordance with manufacturers instructions.

3.3.10 Line Marking and Finishing

After installation is complete, the floor surface shall be cleaned in accordance with installation instructions. Line marking shall be layed out, masked, and painted according to approved detail drawings and approved installation instructions. Finishing shall be in accordance with the manufacturer's recommendations.

3.4 PROTECTION

The installed flooring shall be protected from soiling and damage with heavy reinforced, nonstaining kraft paper, plywood, or hardboard sheets as required. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Protective covering shall be removed when directed by the Contracting Officer.

-- End of Section --

SECTION 09 68 00

CARPET

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 107	(2002) Colorfastness to Water
AATCC 134	(2006) Standard Test Method for Electrostatic Propensity of Carpets
AATCC 16	(2004) Colorfastness to Light
AATCC 165	(1999) Colorfastness to Crocking: Textile Floor Coverings - AATCC Crockmeter Method
AATCC 174	(1998) Antimicrobial Activity Assessment of Carpets

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1423	(2002) Twist in Yarns by Direct-Counting
ASTM D 1667	(2005) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 297	(1993; R 2006) Rubber Products - Chemical Analysis
ASTM D 3278	(1996; R 2004e1) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 3676	(2007) Rubber Cellular Cushion Used for Carpet or Rug Underlay
ASTM D 5252	(2005) Operation of the Hexapod Drum Tester
ASTM D 5417	(2005) Operation of the Vettermann Drum Tester
ASTM D 5793	(2005) Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings
ASTM D 5848	(2005) Mass Per Unit Area of Pile Yarn Floor Coverings
ASTM E 2129	(2005) Standard Practice for Data

	Collection for Sustainability Assessment of Building Products
ASTM E 648	(2006a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(2002) Standard for Installation Specification of Commercial Carpet

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551	(1981) Machine-made Textile Floor Coverings - Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 253	(2005) Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-W-40	(Rev A; Int Am 1, Notice 1) Wall Base: Rubber, and Vinyl Plastic

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1630	Standard for the Surface Flammability of Carpets and Rugs (FF 1-70)
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

WOOLMARK BUSINESS INTELIGENCE (WBI)

Woolmark	(1964) Certification for Use of 100 Percent Wool

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation
Molding

Three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding. Installation drawings for the following items diagramming the location of seams, edge moldings, and carpet direction for approval prior to installation.

1) Carpet Pads
2) Carpet Moldings
3) Base

SD-03 Product Data

Carpet
Carpet Pads
Carpet Moldings
Base

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory. Submit manufacturer's catalog data for the following items:

1) Carpet Pads
2) Carpet Moldings
3) Base

Surface Preparation
Installation

Three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

Regulatory Requirements

Three copies of report stating that carpet and carpet components contain recycled materials and/or involvement in a recycling or reuse program. Include in the report percentage of post-industrial and post-consumer recycled material and relative dollar value of recycled content products to total dollar value of products included in project. Include manufacturer's, independent, third party certification of compliance with Carpet and Rug Institute's Green Label Indoor Air Quality program

Physical Characteristics; (LEED)

Documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project. Documentation indicating relative dollar value of rapidly renewable materials to total dollar value of products included in project.

Local/Regional Materials; (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material

origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

Documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

SD-04 Samples

Carpet
Molding

a. Carpet: Two "Production Quality" samples 18 by 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Two pieces of each type at least 12 inches long.

c. Special Treatment Materials: Two samples showing system and installation method.

SD-06 Test Reports

Moisture and Alkalinity Tests

Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-07 Certificates

Carpet

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

Regulatory Requirements

Report stating that the carpet contains recycled materials and indicating the actual percentage of recycled material. Certificates, showing conformance with the referenced standards contained in this section, for the following:

1) Carpet Pads
2) Carpet Moldings
3) Base

SD-10 Operation and Maintenance Data

Carpet
Cleaning and Protection

Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

Operational Service

Documentation of manufacturer's maintenance agreement, take-back program, green lease for carpet. Include contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

SD-11 Closeout Submittals

Local/Regional Materialss; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Carpet; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Carpet; (LEED)

Adhesives and Concrete Primer; (LEED)

LEED documentation relative to low-emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Carpet; (LEED)

LEED documentation relative to rapidly renewable credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 REGULATORY REQUIREMENTS

Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label for carpet, carpet cushion, and adhesives or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet, carpet cushion, and adhesives bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Procure carpet in accordance with 40 CFR 247, and where possible, purchased locally to reduce emissions of fossil fuels from transporting. Conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS for carpet.

1.4 DELIVERY AND STORAGE

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging

and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues,and maintain at a temperature above 60 degrees F for 2 days prior to installation. Carpet or carpet tiles shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants, including _____. Do not store carpet near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas in which carpeting is to be installed at a temperature above 60 degrees F and below 90 degrees F for 2 days before installation, during installation, and for 2 days after installation. Provide temporary ventilation during work of this section. Maintain a minimum temperature of 55 degrees F thereafter for the duration of the contract. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation. Complete other work which would damage the carpet prior to installation of carpet.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Carpet materials may be locally available.

1.6.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

1.7 SCHEDULING

Install carpet systems after the installation and ventilation period of materials or finishes which have high short-term emissions of VOCs, formaldehyde, particulates, or other air-borne compounds which may be adsorbed by or settle on the carpet tiles, including _____.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and ten (10) year tuft bind and delamination.

1.9 OPERATIONAL SERVICE

Collect information from the manufacturer about maintenance agreement, green lease, options, and submit to Contracting Officer. Service shall reclaim materials for recycling and/or reuse. Service shall not landfill or burn reclaimed materials. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

1.10 EXTRA MATERIAL

Provide extra material from same dye lot consisting of full width

continuous broadloom and uncut carpet tiles for future maintenance. Provide a minimum of 10 percent of total square yards of each carpet type, pattern, and color.

PART 2 PRODUCTS

2.1 CARPET

Furnish first quality carpet; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Provide carpet materials and treatments as reasonably nonallergenic and free of other recognized health hazards. Provide a static control construction on all grade carpets which gives adequate durability and performance. Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) Label. Carpet type bearing the label will indicate that carpet has been tested and meets the criteria of the CRI Green Label Requirements for Indoor Air Quality Test Criteria. Carpet tiles shall have Carpet Component Identification Codes as established by the CRI for future recycling. The labels shall be permanently printed or attached to the carpet backing. The codes shall identify, at minimum, the carpet's face fiber, primary backing, and secondary backing.

2.1.1 Polyester Carpet Face Fibers

For informational purposes, a list of sources known to recycle polyester carpet face fibers is provided below. Note that the Contractor is not limited to these sources. An approved product from other sources may be submitted for the Government's approval during construction. Acceptable manufacturer's include, but are not limited to:

Bretlin, Inc.
LaFayette, Georgia

Central Vermont Carpet
Barre, Vermont

Environmental Building Supplies
Portland, Oregon

Image Industries
Amuchee, Georgia

Martin Color-FI
Edgefield, South Carolina

Talisman Mills, Inc.
Mequon, Wisconsin

2.1.2 Physical Characteristics

2.1.2.1 Broadloom, Modular Tile, Entrance Carpet A

Carpet shall comply with the following:

a. Carpet Construction: Bonded.

b. Type: Broadloom 12, 6 feet minimum usable carpet width with exception of corridors and stairs. Modular tile 24 by 24 inch square with 0.15 percent growth/shrink rate in accordance with

ISO 2551. Entrance 18 by 18 inch square 12, 6 feet width mat size.

c. Pile Type: Level-loop.

d. Pile Fiber: Commercial 100 percent branded (federally registered trademark) nylon continuous filament nylon staple, minimum 5-10 percent post-consumer or 20-40 percent post-industrial recycled content with 25 percent minimum total combined recycled content, wool with Woolmark certification, wool blend with Wool Bureau certification, cotton, jute, sisal, hemp, polylactic acid (PLA), minimum 85-95 percent biobased materials. Chemical treatments, including moth treatment, are permitted with written approval from the Contracting Officer, not permitted polyethylene terephthalate (PET) 100 percent post-consumer recycled fiber, polypropylene. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet pile fiber may contain post-consumer or post-industrial recycled content.

e. Yarn Ply: Minimum 2.

f. Gauge or Pitch: Minimum 1/10 inch in accordance with ASTM D 5793.

g. Stitches or Rows/Wires: Minimum 12 per square inch.

h. Finished Pile Yarn Weight: Minimum .26 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D 5848.

i. Pile Density: Minimum 6600, 02/cuyd.

j. Dye Method: Solution dyed.

k. Backing Materials: Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet, polypropylene, synthetic material, synthetic material, rubber, jute, cotton. Provide secondary backing per manufacturer to suit project requirements of those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is needed, fabric or polymer backing attached with thin layer of styrene butadiene, vinyl (PVC) backing available with dry adhesive, minimal offgassing, natural latex, styrene butadiene with the thinnest layer of styrene butadiene backing available, non-chlorinated polyvinyl butyral (PVB). Backing system shall contain an overall minimum of 85-95 percent natural latex, jute, or cotton, and contain a minimum of 5-10 percent post-consumer recycled content, or minimum 20-40 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet backing may contain post-consumer or post-industrial recycled content.

l. Attached Cushion: Provide an attached cushion chemically frothed polyurethane with minimum weight of 18 oz/sq. yard, minimum density of 11 lb/cubic foot, mechanically frothed polyurethane with minimum weight of 22 oz/sq. yard, minimum density of 14 lb/cubic foot, minimum thickness of 0.100 inch, and maximum compression resistance of 5 psi, and compression set of 15 percent in accordance with ASTM D 3676, minimum 15-50 percent post-consumer recycled content, ethylene vinyl acetate (EVA),

polyvinyl chloride (PVC) with minimum weight of 28 oz/sq. yard, minimum thickness of 0.150 inch, and minimum density of 15 lb/cubic foot and a maximum compression set of 15 percent in accordance with ASTM D 1667, minimum 100 percent recycled content, 100 percent recycled urethane foam, jute with minimum 40 percent post-consumer burlap, wool or cattle hair needled to jute backing containing a minimum of 40 percent post-consumer burlap, felt backing made from cattle hair and jute containing a minimum of 40 percent post-consumer burlap, rubber with minimum 60 percent post-consumer recycled content bonded with styrene butadiene. Do not exceed the maximum ash content of 50 percent when tested in accordance with ASTM D 297. Pass the accelerated aging test in accordance with ASTM D 3676, ASTM D 1667 for the cushion. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet cushion may contain post-consumer or post-industrial recycled content.

m. Recycle Efforts: Use of polyester carpet fiber face, polyethylene terephthalate resin. Use of carpet cushion containing recovered materials. Use of nylon carpet with backing containing recovered carpet. Use of nylon fiber with 25 per cent minimum recycled content. Use of reconditioned nylon carpet.

2.1.2.2 Broadloom, Modular Tile, Entrance Carpet B

Comply with the following carpet requirements:

a. Carpet Construction: Tufted, Woven, Bonded, Needlebond, Needle Felt.

b. Type: Broadloom 12, 6 feet minimum usable carpet width with exception of corridors and stairs. Modular tile 18 by 18, 20 by 20, 24 by 24 inches square with 0.15 percent growth/shrink rate in accordance with ISO 2551. Entrance 18 by 18 inch square 12, 6 feet width mat size.

c. Pile Type: Level-loop, Multilevel loop, Cut and loop, Frieze, Cut pile, Random sheared, Level tip shear.

d. Pile Fiber: Commercial 100 percent branded (federally registered trademark) nylon continuous filament, nylon staple, minimum 5-10 percent post-consumer or 20-40 percent post-industrial recycled content with 25 percent minimum total combined recycled content wool with Woolmark certification, wool blend with Wool Bureau certification, cotton, jute, sisal, hemp, polylactic acid (PLA), minimum 85-95 percent biobased materials. Chemical treatments, including moth treatment, are permitted with written approval from the Government, not permitted, polyethylene terephthalate (PET) 100 percent post-consumer recycled fiber, polypropylene. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet pile fiber may contain post-consumer or post-industrial recycled content.

e. Yarn Ply: Minimum 2 in accordance with ASTM D 1423.

f. Gauge or Pitch: Minimum _____ inch in accordance with ASTM D 5793.

g. Stitches or Rows/Wires: Minimum _____ per square inch.

h. Finished Pile Yarn Weight: Minimum _____ ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D 5848.

i. Pile Density: Minimum _____.

j. Dye Method: Solution dyed, Stock dyed, Yarn (or Skein) dyed, Piece dyed, Space dye, Continuous dye.

k. Backing Materials: Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet, polypropylene, synthetic material, rubber, jute, cotton. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is needed, fabric or polymer backing attached with thin layer of styrene butadiene, vinyl (PVC) backing available with dry adhesive, minimal offgassing, natural latex, styrene butadiene with the thinnest layer of styrene butadiene backing available, non-chlorinated polyvinyl butyral (PVB). Backing system shall contain an overall minimum of 85-95 percent natural latex, jute, or cotton, and contain a minimum of 5-10 percent post-consumer recycled content, or minimum 20-40 percent post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet backing may contain post-consumer or post-industrial recycled content.

l. Attached Cushion: Provide an attached cushion chemically frothed polyurethane with minimum weight of 18 oz/sq. yard, minimum density of 11 lb/cubic foot, mechanically frothed polyurethane with minimum weight of 22 oz/sq. yard, minimum density of 14 lb/cubic foot, minimum thickness of 0.100 inch, and maximum compression resistance of 5 psi, and compression set of 15 percent in accordance with ASTM D 3676, minimum 15-50 percent post-consumer recycled content, ethylene vinyl acetate (EVA), polyvinyl chloride (PVC) with minimum weight of 28 oz/sq. yard, minimum thickness of 0.150 inch, and minimum density of 15 lb/cubic foot and a maximum compression set of 15 percent in accordance with ASTM D 1667, minimum 100 percent recycled content. 100 percent recycled urethane foam, jute with minimum 40 percent post-consumer burlap, wool or cattle hair needled to jute backing containing a minimum of 40 percent post-consumer burlap, felt backing made from cattle hair and jute containing a minimum of 40 percent post-consumer burlap, rubber with minimum 60, 90 percent post-consumer recycled content bonded with styrene butadiene. Do not exceed the maximum ash content of 50 percent when tested in accordance with ASTM D 297. Pass accelerated aging test in accordance with ASTM D 3676, ASTM D 1667 for the cushion. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet cushion may contain post-consumer or post-industrial recycled content.

m. Recycle Efforts: Use of polyester carpet fiber face, polyethylene terephthalate resin, Use of carpet cushion containing recovered materials, Use of nylon carpet with backing containing recovered carpet, Use of nylon fiber with 25 per cent minimum recycled content, Use of reconditioned nylon carpet.

2.1.2.3 Broadloom, Modular Tile, Entrance Carpet C

Comply with the following carpet requirements:

a. Carpet Construction: Tufted, Woven, Bonded, Needlebond, Needle Felt.

b. Type: Broadloom 12, 6 feet minimum usable carpet width with exception of corridors and stairs. Modular tile 18 by 18, 20 by 20, 24 by 24 inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551. Entrance 18 by 18 inch square 12, 6 feet width mat size.

c. Pile Type: Level-loop, Multilevel loop, Cut and loop, Frieze, Cut pile, Random sheared, Level tip shear.

d. Pile Fiber: Commercial 100 percent branded (federally registered trademark) nylon continuous filament, nylon staple, minimum 5-10 percent post-consumer or 20-40 percent post-industrial recycled content with 25 percent minimum total combined recycled content, wool with Woolmark certification, wool blend with Wool Bureau certification, cotton, jute, sisal, hemp, polylactic acid (PLA), minimum 85-95 percent biobased materials. Chemical treatments, including moth treatment, are permitted with written approval from the Government, not permitted, polyethylene terephthalate (PET) 100 percent post-consumer recycled fiber, polypropylene,. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet pile fiber may contain post-consumer or post-industrial recycled content.

e. Yarn Ply: Minimum 2 in accordance with ASTM D 1423.

f. Gauge or Pitch: Minimum _____ inch in accordance with ASTM D 5793.

g. Stitches or Rows/Wires: Minimum _____ per square inch.

h. Finished Pile Yarn Weight: Minimum _____ ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D 5848.

i. Pile Density: Minimum _____.

j. Dye Method: Solution dyed, Stock dyed, Yarn (or Skein) dyed, Piece dyed, Space dye, Continuous dye.

k. Backing Materials: Provide primary backing materials of those customarily used and accepted by the trade for each type of carpet, polypropylene, synthetic material, synthetic material, rubber, jute, cotton. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is needed, fabric or polymer backing attached with thin layer of styrene butadiene, vinyl (PVC) backing available with dry adhesive, minimal offgassing, natural latex, styrene butadiene with the thinnest layer of styrene butadiene backing available, non-chlorinated polyvinyl butyral (PVB). Backing system shall contain an overall minimum of 85-95 percent natural latex, jute, or cotton, and contain a minimum of 5-10 percent post-consumer recycled content, or minimum 20-40 percent

post-industrial recycled content. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet backing may contain post-consumer or post-industrial recycled content.

l. Attached Cushion: Provide an attached cushion chemically frothed polyurethane with minimum weight of 18 oz/sq. yard, minimum density of 11 lb/cubic foot, mechanically frothed polyurethane with minimum weight of 22 oz/sq. yard, minimum density of 14 lb/cubic foot, minimum thickness of 0.100 inch, and maximum compression resistance of 5 psi, and compression set of 15 percent in accordance with ASTM D 3676, minimum 15-50 percent post-consumer recycled content, ethylene vinyl acetate (EVA), polyvinyl chloride (PVC), with minimum weight of 28 oz/sq. yard, minimum thickness of 0.150 inch, and minimum density of 15 lb/cubic foot and a maximum compression set of 15 percent in accordance with ASTM D 1667, minimum 100 percent recycled content, 100 percent recycled urethane foam, jute with minimum 40 percent post-consumer burlap, wool or cattle hair needled to jute backing containing a minimum of 40 percent post-consumer burlap, felt backing made from cattle hair and jute containing a minimum of 40 percent post-consumer burlap, rubber with minimum 60-90 percent post-consumer recycled content bonded with styrene butadiene. Do not exceed the maximum ash content of 50 percent when tested in accordance with ASTM D 297. Pass the cushion accelerated aging test in accordance with ASTM D 3676, ASTM D 1667 for the cushion. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Carpet cushion may contain post-consumer or post-industrial recycled content.

m. Recycle Efforts: Use of polyester carpet fiber face, polyethylene terephthalate resin. Use of carpet cushion containing recovered materials. Use of nylon carpet with backing containing recovered carpet. Use of nylon fiber with 25 per cent minimum recycled content. Use of reconditioned nylon carpet.

2.2 PERFORMANCE REQUIREMENTS

a. ARR (Appearance Retention Rating): Test carpet with the minimum 2.5-3.0 (Moderate), 3.0-3.5 (Heavy), 3.5-4.0 (Severe), ARR in accordance with either the ASTM D 5252 (Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.

b. Static Control: Provide static control to permanently regulate static buildup to less than 3.5, 2.0 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.

c. Flammability and Critical Radiant Flux Requirements: Comply carpet with 16 CFR 1630. Provide carpet in corridors and exits with a minimum average critical radiant flux of 0.22, 0.45 watts per square centimeter when tested in accordance with ASTM E 648.

d. Tuft Bind: Provide tuft bind force required to pull a tuft or loop free from carpet backing with a minimum 10 pound average force for loop pile, 3 pound average force for cut pile.

e. Colorfastness to Crocking: Comply dry and wet crocking with

AATCC 165 and with a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

f. Colorfastness to Light: Comply colorfastness to light with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and with a minimum 4 grey scale rating after 40 hours.

g. Colorfastness to Water: Comply colorfastness to water with AATCC 107 and with a minimum 4.0 gray scale rating and a minimum 4.0 transfer scale rating.

h. Delamination Strength: Provide delamination strength for tufted carpet with a secondary back of minimum 2.5 lbs/inch.

i. Antimicrobial: Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitatiave), guaranteed by the carpet manufacturer to last the life of the carpet.

2.3 CARPET PADS

Provide a sponge rubber pad, 64-ounce flame spread in accordance with NFPA 253.

2.3.1 Carpet Cushion

For informational purposes, a list of sources known to recycle carpet cushions is provided below. Note that the Contractor is not limited to these sources. An approved product from other sources may be submitted for the Government's approval during construction. Acceptable manufacturer's include, but are not limited to:

Collins & Aikman Floor Coverings
Dalton, Georgia

Chris Craft International Products
Waterford, New York

Carpenter Company
Richmond, Virginia

Dixie Manufacturing Corporation
Norfolk, Virginia

2.3.2 Recycling Requirments

Provide bonded polyurethane carpet cushions be made from 15-50 percent of postconsumer content and 15-50 percent, rubber carpet cushions with recycled tire rubber and be made from 60-90 percent of postconsumer content and 60-90 percent, synthetic carpet cushions with recycled carpet fabrication scrap and be made from 100 percent of total recovered materials content.

2.4 CARPET MOLDINGS

Install carpet moldings, either vinyl or aluminum, where floor covering material changes or carpet edge does not abut a vertical surface.

2.5 BASE

Conform to FS SS-W-40 for vinyl base. Provide minimum overall thickness of base not less than 0.125 inch, color as selected from manufacturer's full line. Straight, Cove style, 4, 6 inch high. Furnish base in rolls not less than 96 feet long. Premold corners with wings not less than 2 inch long.

2.6 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers shall comply with applicable regulations regarding toxic and hazardous materials. Use peel and stick dry adhesive, wet adhesive with a maximum VOC content of 50 grams/liter. Provide waterproof, nonflammable, and nonstaining adhesives and concrete primers for carpet installation to meet local air-quality standards, and as required by the carpet manufacturer. Provide release adhesive for modular tile carpet as recommended by the carpet manufacturer. Provide adhesives flashpoint of minimum 140 degrees F in accordance with ASTM D 3278.

2.7 MOLDING

Provide a hammered surface aluminum molding, pinless clamp-down type, designed for the type of carpet being installed. Provide natural color anodized, prefinished color finish. Provide a floor flange of a minimum 1-1/2 inch wide and face a minimum 5/8 inch wide, heavy-duty vinyl molding designed for the type of carpet being installed. Provide floor flange of a minimum 2 inches wide. Provide _____ color.

2.8 TAPE

Provide tape for seams as recommended by the carpet manufacturer for the type of seam used in installation. Any seam sealant shall have a maximum VOC content of 50 grams/liter. Do not use sealants that contain 1,1,1-trichloroethane or toluene.

2.9 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with Section 09 06 90 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab shall for moisture content and excessive alkalinity in accordance with CRI 104.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting shall until concrete substrate is at least 90 days old. Prepare the concrete surfaces in

accordance with instructions of the carpet manufacturer. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling agents, and concrete sealer.

3.4 INSTALLATION

Isolate area of installation from rest of building. Perform all work by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI 104. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Mothproofing for wool carpets shall use autofoam mothproofing system. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation.

3.4.1 Broadloom Installation

Install broadloom carpet direct glue down, pre-applied adhesive glue down, and smooth, uniform, and secure, with a minimum of seams. Apply regular, unnoticeable, and treated seams with a seam adhesive. Run side seams toward the light, where practical, and where such layout does not increase the number of seams. Install breadths parallel, with carpet pile in the same direction. Match patterns accurately. Neatly cut and fit cutouts, at door jambs, columns and ducts securely. Locate seams at doorways parallel to and centered directly under doors. Do not make seams perpendicular to doors or at pivot points. Provide seams at changes in directions of corridors to follow the wall line parallel to the carpet direction. Lay the carpet lengthwise down the corridors with widths less than 6 feet.

3.4.2 Modular Tile Installation

Install modular tiles with permanent vinyl-compatible, release adhesive and snugly jointed together. Lay tiles in the same direction, an alternating pattern with accessibility to the subfloor where required.

3.4.3 Entrance Carpet Installation

Install tiles with permanent vinyl-compatible, release adhesive and shall be snugly jointed together. Lay tiles in the same direction, an alternating pattern. Install roll goods direct glue down, pre-applied adhesive glue down, and smooth, uniform, and secure, with a minimum of seams. Prepare regular, unnoticeable, and treated seams with a seam adhesive. Install breadths parallel, with carpet pile in the same direction. Match patterns accurately. Neatly cut and fit, securely, cutouts at door jambs, columns, and ducts. Locate seams at doorways parallel to and centered directly under doors. Do not make seams perpendicular to doors or at pivot points. Cut mats to specified size and finish them with a tapered vinyl edge that is glued and sewn on.

3.4.4 Stretch-in Installation

Provide carpet anchors wherever carpeting abuts vertical surfaces. Install tackless carpet stripping by nailing. Place carpet cushion face-up, as recommended by cushion manufacturer, over entire floor area to be carpeted with joints butted. Do not use adhesives to attach carpet, pad, or substrate. Comply with carpet manufacturer's instructions for

installation. Attach rubber or metal edge strip to substrate with adhesive.

3.5 CLEANING AND PROTECTION

3.5.1 Cleaning

As specified in Section 01 78 00 CLOSEOUT SUBMITTALS. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the Contracting Officer.

3.6 REMNANTS

Collect information from manufacturer about maintenance agreement, take-back program options, and provide to Contracting Officer. Manage waste as specified in the Waste Management Plan. Provide remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total to the Government, to local non-profit such as Habitat for Humanity as directed by the Government. Non-retained scraps shall be set aside and returned to manufacturer for recycling into new product. Remove non-retained scraps from site and recycle appropriately.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS

10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc	(2005) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007) Scheme for the Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 669	(2000) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 2092	(1995; R 2001e1) Standard Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 235	(2002) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 2824	(2006) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos
ASTM D 4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4263	(1983; R 2005) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(1992; R 2003) Use and Calibration of Hand-Held Moisture Meters
ASTM D 523	(1989; R 1999) Standard Test Method for Specular Gloss

ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM F 1869	(2004) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 1	(Jan 2004) Aluminum Paint
MPI 10	(Jan 2004) Exterior Latex, Flat, MPI Gloss Level 1
MPI 101	(Jan 2004) Epoxy Anti-Corrosive Metal Primer
MPI 107	(Jan 2004) Rust Inhibitive Primer (Water-Based)
MPI 108	(Jan 2004) High Build Epoxy Coating, Low Gloss
MPI 11	(Jan 2004) Exterior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 113	(Jan 2004) Exterior Pigmented Elastomeric Coating (Water Based)
MPI 116	(Jan 2004) Epoxy Block Filler
MPI 119	(Jan 2004) Exterior Latex, Gloss
MPI 13	(Jan 2004) Exterior Solvent-Based Semi-Transparent Stain
MPI 134	(Jan 2004) Galvanized Primer (Waterbased)
MPI 138	(Jan 2004) Interior High Performance Latex, MPI Gloss Level 2
MPI 139	(Jan 2004) Interior High Performance Latex, MPI Gloss Level 3
MPI 140	(Jan 2004) Interior High Performance Latex, MPI Gloss Level 4
MPI 141	(Jan 2004) Interior High Performance Latex MPI Gloss Level 5
MPI 144	(Jan 2004) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 2
MPI 145	(Jan 2004) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 3
MPI 146	(Jan 2004) Institutional Low Odor/VOC Interior Latex, MPI Gloss Level 4

MPI 147	(Jan 2004) Institutional Low Odor / VOC Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 151	(Jan 2006) Interior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 153	(Jan 2006) Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 154	(Jan 2006) Interior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 16	(Jan 2004) Exterior Latex-Based Solid Hide Stain
MPI 161	(Jan 2006) Exterior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 163	(Jan 2006) Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 164	(Jan 2006) Exterior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 19	(Jan 2004) Inorganic Zinc Rich Primer
MPI 2	(Jan 2004) Aluminum Heat Resistant Enamel (up to 427 C and 800 F
MPI 21	(Jan 2004) Heat Resistant Enamel, Gloss (up to 205 degrees C and 400 degrees F), MPI Gloss Level 6
MPI 22	(Jan 2004) Aluminum Paint, High Heat (up to 590 degrees C and 1100 degrees F.
MPI 23	(Jan 2004) Surface Tolerant Metal Primer
MPI 26	(Jan 2004) Cementitious Galvanized Metal Primer
MPI 27	(Jan 2004) Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 31	(Jan 2004) Polyurethane, Moisture Cured, Clear Gloss
MPI 39	(Jan 2004) Interior Latex-Based Wood Primer
MPI 4	(Jan 2004) Interior/Exterior Latex Block Filler
MPI 42	(Jan 2004) Latex Stucco and Masonry Textured Coating
MPI 44	(Jan 2004) Interior Latex, MPI Gloss Level 2

MPI 45	(Jan 2004) Interior Alkyd Primer Sealer
MPI 46	(Jan 2004) Interior Enamel Undercoat
MPI 47	(Jan 2004) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 48	(Jan 2004) Interior Alkyd, Gloss, MPI Gloss Level 6
MPI 49	(Jan 2004) Interior Alkyd, Flat, MPI Gloss Level 1
MPI 5	(Jan 2004) Exterior Alkyd Wood Primer
MPI 50	(Jan 2004) Interior Latex Primer Sealer
MPI 51	(Jan 2004) Interior Alkyd, Eggshell, MPI Gloss Level 2
MPI 52	(Jan 2004) Interior Latex, MPI Gloss Level 3
MPI 54	(Jan 2004) Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 56	(Jan 2004) Interior Oil Modified Urethane Clear Gloss
MPI 57	(Jan 2004) Interior Oil Modified Urethane Clear Satin
MPI 59	(Jan 2004) Interior/Exterior Floor Enamel, Low Gloss
MPI 6	(Jan 2004) Exterior Latex Wood Primer
MPI 60	(Jan 2004) Interior/Exterior Latex Floor Paint, Low Gloss
MPI 68	(Jan 2004) Interior/Exterior Latex Floor Enamel, Gloss
MPI 7	(Jan 2004) Exterior Oil Wood Primer
MPI 71	(Jan 2004) Polyurethane, Moisture Cured, Clear, Flat
MPI 72	(Jan 2004) Polyurethane, Two Component, Pigmented, Gloss
MPI 77	(Jan 2004) Epoxy Gloss
MPI 79	(Jan 2004) Alkyd Anti-Corrosive Metal Primer
MPI 8	(Jan 2004) Exterior Alkyd, Flat, MPI Gloss Level I

MPI 9	(Jan 2004) Exterior Alkyd, Gloss, MPI Gloss Level 6
MPI 90	(Jan 2004) Interior Wood Stain, Semi-Transparent
MPI 94	(Jan 2004) Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 95	(Jan 2004) Quick Drying Primer for Aluminum

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP-01	(2000) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Guide 6	(2004) Guide for Containing Debris Generated During Paint Removal Operations
SSPC Guide 7	(2004; E 2004) Guide for the Disposal of Lead-Contaminated Surface Preparation Debris
SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting
SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC Paint 18	(1982; E 2004) Paint Specification No. 18 Chlorinated Rubber Intermediate Coat Paint
SSPC QP 1	(1998; E 2004) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10	(2007) Near-White Blast Cleaning
SSPC SP 12	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	(1982; E 2004) Hand Tool Cleaning
SSPC SP 3	(2004; E 2004) Power Tool Cleaning
SSPC SP 6	(2000; E 2004) Commercial Blast Cleaning
SSPC SP 7	(2007) Brush-Off Blast Cleaning
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

SSPC VIS 3	(2004) Visual Standard for Power-and Hand-Tool Cleaned Steel
SSPC VIS 4	(1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2003) Safety -- Safety and Health Requirements

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-680	(Rev B) Degreasing Solvent
MIL-STD-101	(Rev B) Color Code for Pipelines & for Compressed Gas Cylinders

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	(2000) Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev K) Obstruction Marking and Lighting

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(Rev D; Am 1) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD-595	(Rev B; Am 1) Colors Used in Government Procurement

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1001	Asbestos
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Local/Regional Materials; (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

Materials; (LEED)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Coating

Manufacturer's Technical Data Sheets; (LEED)

Indicate VOC content.

Sealant

SD-04 Samples

Color

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

Textured Wall Coating System

Sample Textured Wall Coating System Mock-Up

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings:

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

SD-11 Closeout Submittals

Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Materials; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on _____ on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.3.2 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced

specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

Another required testing is Batch Quality Conformance Testing to prove conformance of the manufacturer's paint to the specified MPI standard. This testing is accomplished before the materials are delivered to the job site. Provide testing for 2 coatings paint products. Test paint products as specified in the paragraph "Testing Procedure".

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.4.2 Textured Wall Coating System

Three complete samples of each indicated type, pattern, and color of textured wall coating system applied to a panel of the same material as that on which the coating system will be applied in the work. Samples of wall coating systems shall be minimum 125 x 175 mm (5 x 7 inches) and of sufficient size to show pattern repeat and texture.

1.4.3 Sample Textured Wall Coating System Mock-Up

After coating samples are approved, and prior to starting installation, a minimum 2430 mm x 2430 mm (8 foot x 8 foot) mock-up shall be provided for each substrate and for each color and type of textured wall coating, using the actual substrate materials. Once approved the mock-up samples shall be used as a standard of workmanship for installation within the facility. At

least 48 hours prior to mock-up installation, the Contractor shall submit written notification to the Contracting Officer's Representative.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to adsorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100Doc, threshold limit values.

d. The appropriate OSHA standard in 29 CFR 1910.1025 and 29 CFR 1926.62 for surface preparation on painted surfaces containing lead. Removal and disposal of coatings which contain lead is specified in Section 02 83 19.00 10 LEAD BASED PAINT HAZARD ABATEMENT, TARGET HOUSING AND CHILD OCCUPIED FACILITIES, Section 02 83 13.00 20 LEAD IN CONSTRUCTION, Section 02 82 33.13 20 REMOVAL/CONTROL AND DISPOSAL OF LEAD PAINT." Additional guidance is given in SSPC Guide 6 and SSPC Guide 7. Refer to drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.

e. The appropriate OSHA standards in 29 CFR 1910.1001 for surface preparation of painted surfaces containing asbestos. Removal and disposal of coatings which contain asbestos materials is specified in Section 02 82 16.00 20 ENGINEERING CONTROL OF ASBESTOS CONTAINING MATERIALS, Section 02 82 14.00 10 ASBESTOS ABATEMENT AND CONTROL. Refer to drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.

1.8 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product

manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.8.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 85 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.9 SUSTAINABLE DESIGN REQUIREMENTS

1.9.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Paint and coating materials may be locally available.

1.9.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

1.10 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs, including _____.

1.11 COLOR SELECTION

Color Coding For Shore-To-Ship Utility Connections: Paint hose connection fittings and shut-off valves the designated color. In addition to color coding provide 2 inch high stenciled letters using black stencil paint, clearly designating service for each connection.

Color Coding for Shore-to-Ship
Utility Connections

Service	Color	FED-STD-595 No.
Potable Water*	Blue	15044
Water Provided for Fire Protection**	Red	11105
Chilled Water	Striped Blue/White	15044/17886
Oily Waste Water	Striped Yellow/Black	13538/17038

Color Coding for Shore-to-Ship
Utility Connections

Service	Color	FED-STD-595 No.
Sewer	Gold	17043
Steam	White	17886
High Pressure Air	Gray	16081
Low Pressure Air	Tan	10324
Fuel	Yellow	13655

* This includes connections serving domestic functions.

** This includes non-potable salt water or, at some locations, fresh water connections provided for fire protection (may also include flushing and cooling requirements). Note: This does not include waterfront fire hydrants.

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be as indicated, in accordance with Section 09 06 90 COLOR SCHEDULE.

1.12 LOCATION AND SURFACE TYPE TO BE PAINTED

1.12.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.12.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the buildings and appurtenances. Also included are existing

coated surfaces made bare by cleaning operations.

1.12.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.12.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

f. Surfaces in the following areas shall not be painted: _____.

1.12.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new and existing surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation

(2) New aluminum jacket on piping

(3) New interior ferrous piping under insulation.

1.12.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material. In lieu of red enamel finish coat, provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals.

b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems.

1.12.4 Exterior Painting of Site Work Items

Field coat the following items: As indicated.

	New Surfaces	Existing Surfaces
a.	_____	_____
b.	_____	_____
c.	_____	_____

1.12.5 MISCELLANEOUS PAINTING

Lettering Building Room Number(s)

Lettering shall be provided as scheduled on the drawings, shall be block, Gothic type, and shall be black enamel, water-type decalcomania, finished with a protective coating of spar varnish. Samples shall be approved before application.

Obstructions To Aviation

The following obstructions to aviation shall be painted in the pattern and color prescribed by FAA AC 70/7460-1.

1.12.6 Definitions and Abbreviations

1.12.6.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.12.6.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.12.6.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.12.6.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.12.6.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.12.6.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.12.6.7 EXT

MPI short term designation for an exterior coating system.

1.12.6.8 INT

MPI short term designation for an interior coating system.

1.12.6.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.12.6.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.12.6.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.12.6.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.12.6.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.12.6.14 Paint

See Coating definition.

1.12.6.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.12.6.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 REPUTTYING AND REGLAZING

Remove cracked, loose, and defective putty or glazing compound on glazed sash and provide new putty or glazing compound. Where defective putty or glazing compound constitutes 30 percent or more of the putty at any one light, remove the glass and putty or glazing compound and reset the glass. Remove putty or glazing compound without damaging sash or glass. Clean rabbets to bare wood or metal and prime prior to reglazing. Putty for wood sash shall be a linseed oil putty. Glazing compound for metal sash shall conform to ASTM C 669. Patch surfaces to provide smooth transition between existing and new surfaces. Finish putty or glazing compound to a neat and true bead. Allow glazing compound time to cure, in accordance with manufacturer's recommendation, prior to coating application. Allow putty to set one week prior to coating application.

3.3 RESEALING OF EXISTING EXTERIOR JOINTS

3.3.1 Surface Condition

Surfaces shall be clean, dry to the touch, and free from frost and moisture; remove grease, oil, wax, lacquer, paint, defective backstop, or other foreign matter that would prevent or impair adhesion. Where adequate grooves have not been provided, clean out to a depth of 1/2 inch and grind to a minimum width of 1/4 inch without damage to adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Backstops

In joints more than 1/2 inch deep, install glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free of oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

3.3.3 Primer and Bond Breaker

Install the type recommended by the sealant manufacturer.

3.3.4 Ambient Temperature

Between 38 degrees F and 95 degrees F when applying sealant.

3.3.5 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Color(s) shall be selected by the Contracting Officer. Apply the sealant in accordance with the manufacturer's printed instructions. Force sealant into joints with sufficient pressure to fill the joints solidly. Sealant shall be uniformly smooth and free of wrinkles.

3.3.6 Cleaning

Immediately remove fresh sealant from adjacent areas using a solvent recommended by the sealant manufacturer. Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean condition. Allow sealant time to cure, in accordance with manufacturer's recommendations, prior to coating.

3.4 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.4.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, refer to paragraph Toxic Materials.

b. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D 235. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

c. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

d. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

e. Previously painted surfaces specified to be repainted, damaged

during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.

f. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

g. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.

h. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.

i. Edges of chipped paint shall be feather edged and sanded smooth.

j. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.

k. New, proposed coatings shall be compatible with existing coatings.

3.4.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding or blasting so that when tested in accordance with ASTM D 4214, the chalk rating is not less than 8.

3.4.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

a. Surfaces containing large areas of minor defects;

b. Surfaces containing more than 20 percent peeling area; and

c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

3.4.4 Substrate Repair

a. Repair substrate surface damaged during coating removal;

b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

c. Clean and prime the substrate as specified.

3.5 PREPARATION OF METAL SURFACES

3.5.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10.

Brush-off blast remaining surface in accordance with SSPC SP 7; Water jetting to SSPC SP 12 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3, SSPC SP 10/SSPC SP 12 WJ-2.

c. Metal Floor Surfaces to Receive Nonslip Coating: Clean in accordance with SSPC SP 10, SSPC SP 12 WJ-2.

3.5.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.5.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12 WJ3 degree of cleanliness. Spot abrasive blast rusted areas as described for steel in SSPC SP 6, and waterjet to SSPC SP 12, WJ3 to remove existing coating.

3.5.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.5.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

3.5.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.6 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.6.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cuphousehold detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new, existing coated, and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

(5) Removal of Existing Coatings: For surfaces to receive textured coating MPI 42, remove existing coatings including soundly adhered coatings if recommended by textured coating manufacturer.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In

all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.6.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.6.3 Existing Asbestos Cement Surfaces

Remove oily stains by solvent cleaning with mineral spirits, MIL-PRF-680, ASTM D 235. Remove loose dirt, dust, and other deleterious substances by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material. Do not wire brush or clean using other abrasive methods. Surfaces shall be dry and clean prior to application of the coating.

3.7 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.7.1 New, Existing Uncoated, and Existing Coated Plywood and Wood Surfaces, Except Floors:

a. Wood surfaces shall be cleaned of foreign matter.

Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.

b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

c. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.

d. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned

paints.

e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

f. Cosmetic Repair of Minor Defects:

(1) Knots and Resinous Wood and Fire, Smoke, Water, and Color Marker Stained Existing Coated Surface: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

(2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

(3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

g. Prime Coat For New Exterior Surfaces: Prime coat wood doors, windows, frames, and trim before wood becomes dirty, warped, or weathered.

3.7.2 Wood Floor Surfaces, Natural Finish

a. Initial Surface Cleaning: As specified in paragraph entitled "Surface Preparation."

b. Existing Loose Boards and Shoe Molding: Before sanding, renail loose boards. Countersink nails and fill with an approved wood filler. Remove shoe molding before sanding and reinstall after completing other work. At Contractor's option, new shoe molding may be provided in lieu of reinstalling old. New wood molding shall be same size, wood species, and finish as the existing.

c. Sanding and Scraping: Sanding of wood floors is specified in Section 09 64 29 WOOD STRIP FLOORING, 09 64 23 WOOD PARQUET FLOORING, 09 64 66 WOOD ATHLETIC FLOORING, 09 64 00 PORTABLE (DEMOUNTABLE) WOOD FLOORING. Floors of oak or similar open-grain wood shall be filled with wood filler recommended by the finish manufacturer and the excess filler removed.

d. Final Cleaning: After sanding, sweep and vacuum floors clean. Do not walk on floors thereafter until specified sealer has been applied and is dry.

3.7.3 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

3.7.4 Water Blasting of Existing Coated Wood Surfaces:

Water blasting shall be provided for the following surfaces: _____.

a. Sample Panel: Prior to the initial surface cleaning, water blast a representative surface designated by the Contracting Officer. Final surface condition of remaining work shall be similar to sample panel approved by the Contracting Officer.

b. Initial Surface Cleaning: Water blasting shall consist of washing surfaces to receive paint with a high pressure spray, to remove loose paint, dirt, and other foreign or deleterious materials. The working pressure shall be between 400 and 700 pounds per square inch gage (psig) at a nozzle operating rate of a minimum 20 gallons per minute (g/min.). Do not flood vents or damage windows and floors. If the pressure specified will cause damage to existing wood, advise the Contracting Officer and obtain permission to vary the pressure. Direct the wash nozzle at the surface at an angle of approximately 75 degrees with the surface and at a distance not greater than 5 feet to apply water pressure required to remove loose paint, dirt, chalking, and other foreign matter.

c. Final Surface Cleaning: After allowing the surfaces to dry for a minimum of 24 hours, remove remaining dirt, splinters, loose particles, disintegrated and loose paint, grease, oil, and other foreign matter from the surface.

3.8 APPLICATION

3.8.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of

coating material.

Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 1.0 mil. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat. For nonslip surfacing on ramps, provide MPI 77 with non-skid additive, applied by roller in accordance with manufacturer's instructions.

3.8.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 0.125 L, 1 pint of suitable thinner per

liter, gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.8.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.8.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table
Division 9: Exterior Stucco Paint Table
Division 10. Exterior Cloth Coverings and Bituminous Coated Surfaces Paint Table

Division 3. Interior Concrete Paint Table
Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered

and in good condition. Do not omit undercoats or primers.

3.9 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.10 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.11 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

d. Wood Floors to Receive Natural Finish: Thin first coat 2 to 1 using thinner recommended by coating manufacturer. Apply all coatings at rate of 300 to 350 square feet per gallon. Apply second coat not less than 2 hours and not over 24 hours after first coat has been applied. Apply with lambs wool applicators or roller as recommended by coating manufacturer. Buff or lightly sand between intermediate coats as recommended by coating manufacturer's printed instructions.

3.12 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101, ASME A13.1. Place stenciling in clearly

visible locations. On piping not covered by MIL-STD-101, ASME A13.1, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.13 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.14 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, local recyclers shall be sought after to reclaim the materials. Set aside extra paint for future color matches or reuse by the Government. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local organizations.

3.15 PAINT TABLES

All DFT's are minimum values. Use only materials with a GPS green check mark having a minimum MPI "Environmentally Friendly" E1, E2, E3 rating based on VOC (EPA Method 24) content levels. Use only interior paints and coatings that meet VOC requirements of LEED low emitting materials credit. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.15.1 EXTERIOR PAINT TABLES

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

A. New and uncoated existing and Existing, previously painted concrete; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. Latex

New; MPI EXT 3.1A-G2 (Flat) / Existing; MPI REX 3.1A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 10	MPI 10	MPI 10

System DFT: 3.5 mils

New; MPI EXT 3.1A-G5 (Semigloss) / Existing; MPI EXT 3.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 11	MPI 11	MPI 11

System DFT: 3.5 mils

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

New; MPI EXT 3.1A-G6 (Gloss) / Existing; MPI REX 3.1A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 119	MPI 119	MPI 119

System DFT: 3.5 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.

B. New and uncoated existing and Existing, previously painted concrete, textured system; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. Latex Aggregate

New; MPI EXT 3.1B-G2 (Flat) / Existing; MPI REX 3.1B-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 42	MPI 10	MPI 10

System DFT: Per Manufacturer

New; MPI EXT 3.1B-G5 (Semigloss) / Existing; MPI REX 3.1B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 42	MPI 11	MPI 11

System DFT: Per Manufacturer

New; MPI EXT 3.1B-G6 (Gloss) / Existing; MPI REX 3.1B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 42	MPI 119	MPI 119

System DFT: Per Manufacturer

Texture - Fine, Medium, Coarse. Surface preparation and number of coats in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.

C. New and uncoated existing and Existing, previously painted concrete, elastomeric System; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. Elastomeric Coating

New; MPI EXT 3.1F / Existing; MPI REX 3.1F

Primer:	Intermediate:	Topcoat:
Per Manufacturer	MPI 113	MPI 113

System DFT: 16 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions.

NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 16 mils .

D. New and uncoated existing and Existing, previously painted concrete: walls and bottom of swimming pools.

1. Chlorinated Rubber

New; / Existing;

Primer:	Intermediate:	Topcoat:
SSPC Paint 18	SSPC Paint 18	SSPC Paint 18

System DFT: Per Manufacturer

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE
NOTE: Thin first coat (primer) with 1 part of approved thinner to 4 parts of paint by volume.

E. New and Existing Cementitious composition board (including Asbestos cement board):

1. Latex
New; MPI EXT 3.3A-G1 (Flat) /Existing; MPI REX 3.3A-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 10 MPI 10 MPI 10
System DFT: 4.5 mils

New; MPI EXT 3.3A-G5 (Semigloss) / Existing; MPI REX 3.3A-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 11 MPI 11 MPI 11
System DFT: 4.5 mils

New; MPI EXT 3.3A-G6 (Gloss) / Existing; MPI REX 3.3A-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 119 MPI 119 MPI 119
System DFT: 4.5 mils

Topcoat: Coating to match adjacent surfaces.

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New and Existing concrete masonry on uncoated surface:

1. Latex
New; MPI EXT 4.2A-G1 (Flat) / Existing; MPI REX 4.2A-G1 (Flat)
Block Filler: Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 10 MPI 10
System DFT: 11 mils

New; MPI EXT 4.2A-G5 (Semigloss) / Existing; MPI REX 4.2A-G5 (Semigloss)
Block Filler: Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 11 MPI 11
System DFT: 11 mils

New; MPI EXT 4.2A-G6 (Gloss) / Existing; MPI REX 4.2A-G6 (Gloss)
Block Filler: Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 119 MPI 119
System DFT: 11 mils

Topcoat: Coating to match adjacent surfaces.

B. New and Existing concrete masonry, textured system; on uncoated surface:

1. Latex Aggregate
New; MPI EXT 4.2B-G1 (Flat) / Existing; MPI REX 4.2B-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 42 MPI 42 MPI 10
System DFT: Per Manufacturer

New; MPI EXT 4.2B-G5 (Semigloss) / Existing; MPI REX 4.2B-G5 (Semigloss)
Primer: Intermediate: Topcoat:

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

MPI 42 MPI 42 MPI 11
System DFT: Per Manufacturer

New; MPI EXT 4.2B-G6 (Gloss) / Existing; MPI REX 4.2B-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 42 MPI 42 MPI 119
System DFT: Per Manufacturer

Texture - Fine, Medium, Coarse. Surface preparation and number of coats in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.

C. New and Existing concrete masonry, elastomeric system; on uncoated surface:

1. Elastomeric Coating
New; MPI EXT 4.2D / Existing; MPI REX 4.2D
Primer: Intermediate: Topcoat:
Per Manufacturer MPI 113 MPI 113
System DFT: 16 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions.

NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 16 mils.

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. Alkyd
New; MPI EXT 5.1Q-G5 (Semigloss) Existing; MPI REX 5.1D-G5
Primer: Intermediate: Topcoat:
MPI 23 MPI 94 MPI 94
System DFT: 5.25 mils

New; MPI EXT 5.1Q-G6 (Gloss) / Existing; MPI REX 5.1D-G6
Primer: Intermediate: Topcoat:
MPI 23 MPI 9 MPI 9
System DFT: 5.25 mils

B. New Steel that has been blast-cleaned to SSPC SP 6:

2. Alkyd
New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5
Primer: Intermediate: Topcoat:
MPI 79 MPI 94 MPI 94
System DFT: 5.25 mils

New; MPI EXT 5.1D-G6 (Gloss) / Existing; MPI REX 5.1D-G6
Primer: Intermediate: Topcoat:
MPI 79 MPI 9 MPI 9

STEEL / FERROUS SURFACES
System DFT: 5.25 mils

C. Existing steel that has been spot-blasted to SSPC SP 6:

1. Surface previously coated with alkyd or latex:

Waterborne Light Industrial Coating
MPI REX 5.1C-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 79	MPI 163	MPI 163

System DFT: 5 mils

MPI REX 5.1C-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 79	MPI 164	MPI 164

System DFT: 5 mils

2. Surface previously coated with epoxy:

Waterborne Light Industrial
a. MPI REX 5.1L-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 101	MPI 163	MPI 163

System DFT: 5 mils

MPI REX 5.1L-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 101	MPI 164	MPI 164

System DFT: 5 mils

Pigmented Polyurethane
b. MPI REX 5.1H-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 72

System DFT: 8.5 mils

D. New and existing steel blast cleaned to SSPC SP 10:

1. Waterborne Light Industrial
MPI EXT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 163

System DFT: 8.5 mils

MPI EXT 5.1R-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 164

System DFT: 8.5 mils

2. Pigmented Polyurethane
MPI EXT 5.1J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 72

System DFT: 8.5 mils

E. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

STEEL / FERROUS SURFACES

1. Alkyd Floor Enamel
   MPI EXT 5.1S-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 27	MPI 27 (+NSA)

   System DFT: 5.25 mils

EXTERIOR GALVANIZED SURFACES

F. New Galvanized surfaces:

1. Cementitious primer / Latex
   MPI EXT 5.3A-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 26	MPI 10	MPI 10

   System DFT: 4.5 mils

   MPI EXT 5.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 26	MPI 11	MPI 11

   System DFT: 4.5 mils

   MPI EXT 5.3A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 26	MPI 119	MPI 119

   System DFT: 4.5 mils

2. Waterborne Primer / Latex
   MPI EXT 5.3H-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 10	MPI 10

   System DFT: 4.5 mils

   MPI EXT 5.3H-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 11	MPI 11

   System DFT: 4.5 mils

   MPI EXT 5.3H-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 119	MPI 119

   System DFT: 4.5 mils

3. Waterborne Primer / Waterborne Light Industrial Coating
   MPI EXT 5.3J-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 163	MPI 163

   System DFT: 4.5 mils

   MPI EXT 5.3J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 134	MPI 164	MPI 164

   System DFT: 4.5 mils

4. Epoxy Primer / Waterborne Light Industrial Coating
   MPI EXT 5.3K-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 163	MPI 163

   System DFT: 5 mils

EXTERIOR GALVANIZED SURFACES

MPI EXT 5.3K-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 164 MPI 164
System DFT: 5 mils

5. Pigmented Polyurethane
MPI EXT 5.3L-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 101 N/A MPI 72
System DFT: 5 mils

G. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Waterborne Light Industrial Coating
MPI REX 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 N/A MPI 163
System DFT: 4.5 mils

2. Pigmented Polyurethane
MPI REX 5.3D-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 101 N/A MPI 72
System DFT: 5 mils

H. Galvanized surfaces with severely deteriorated coating or rusting:

1. Waterborne Light Industrial Coating
MPI REX 5.3L-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 163
System DFT: 8.5 mils

MPI REX 5.3L-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 164
System DFT: 8.5 mils

2. Pigmented Polyurethane
MPI REX 5.3K-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 72
System DFT: 5 mils

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

I. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
MPI EXT 5.4F-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 95 MPI 8 MPI 8
System DFT: 5 mils

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

MPI EXT 5.4F-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 94 MPI 94
System DFT: 5 mils

MPI EXT 5.4F-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 9 MPI 9
System DFT: 5 mils

2. Waterborne Light Industrial Coating
MPI EXT 5.4G-G3(Eggshell)
Primer: Intermediate: Topcoat:
MPI 95 MPI 161 MPI 161
System DFT: 5 mils

MPI EXT 5.4G-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 163 MPI 163
System DFT: 5 mils

MPI EXT 5.4G-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 164 MPI 164
System DFT: 5 mils

I. Existing roof surfaces previously coated:

1. Aluminum Pigmented Asphalt Roof Coating
ASTM D 2824: Sufficient coats to provide not less than 8 mils of finished coating system (without asbestos fibers).

2. Aluminum Paint
MPI REX 10.2D
Primer: Intermediate: Topcoat:
MPI 107 MPI 1 MPI 1
System DFT: 3.5 mils

J. Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
MPI EXT 5.1D-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 79 MPI 8 MPI 8
System DFT: 5.25 mils

MPI EXT 5.1D-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 94 MPI 94
System DFT: 5.25 mils

MPI EXT 5.1D-G6 (Gloss)
Primer: Intermediate: Topcoat:

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)
MPI 79 MPI 9 MPI 9
System DFT: 5.25 mils

2. Waterborne Light Industrial Coating
MPI EXT 5.1C-G3(Eggshell)
Primer: Intermediate: Topcoat:
MPI 79 MPI 161 MPI 161
System DFT: 5 mils

MPI EXT 5.1C-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 163 MPI 163
System DFT: 5 mils

MPI EXT 5.1C-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 164 MPI 164
System DFT: 5 mils

K. Hot metal surfaces including smokestacks subject to temperatures up to 205 degrees C (400 degrees F):

1. Heat Resistant Enamel
MPI EXT 5.2A
Primer: Intermediate: Topcoat:
MPI 21 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

L. Ferrous metal subject to high temperature, up to 400 degrees C (750 degrees F):

1. Inorganic Zinc Rich Coating
MPI EXT 5.2C
Primer: Intermediate: Topcoat:
MPI 19 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

2. Heat Resistant Aluminum Enamel
MPI EXT 5.2B (Aluminum Finish)
Primer: Intermediate: Topcoat:
MPI 2 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

M. New surfaces and Existing surfaces made bare cleaning to SSPC SP 10 subject to temperatures up to 593 degrees C (1100 degrees F):

1. Heat Resistant Coating
MPI EXT 5.2D
Primer: Intermediate: Topcoat:
MPI 22 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

A. New and Existing, uncoated Dressed lumber, Wood and plywood, trim, including top, bottom and edges of doors not otherwise specified:

1. Alkyd
   MPI EXT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 94	MPI 94

   System DFT: 5 mils

   MPI EXT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 9	MPI 9

   System DFT: 5 mils

2. Latex
   MPI EXT 6.3A-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 10	MPI 10

   System DFT: 5 mils

   MPI EXT 6.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 11	MPI 11

   System DFT: 5 mils

   MPI EXT 6.3A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 119	MPI 119

   System DFT: 5 mils

3. Waterborne Solid Color Stain
   MPI EXT 6.3K

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 16	MPI 16

   System DFT: 4.25 mils

B. Existing, dressed lumber, Wood and plywood, trim, including top, bottom and edges of doors previously coated with an alkyd / oil based finish coat not otherwise specified:

1. Alkyd
   MPI REX 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 5	MPI 94	MPI 94

   System DFT: 5 mils

   MPI REX 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 5	MPI 9	MPI 9

   System DFT: 5 mils

2. Latex
   MPI REX 6.3A-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 5	MPI 10	MPI 10

   System DFT: 5 mils

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

MPI REX 6.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 5	MPI 11	MPI 11

System DFT: 5 mils

MPI REX 6.3A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 5	MPI 119	MPI 119

System DFT: 5 mils

C. Existing, dressed lumber, Wood and plywood, trim, including top, bottom and edges of doors previously coated with a latex / waterborne finish coat not otherwise specified:

1. Latex

MPI REX 6.3L-G1 (Flat)

Spot Primer:	Intermediate:	Topcoat:
MPI 6	MPI 10	MPI 10

System DFT: 4.5 mils

MPI REX 6.3L-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 6	MPI 11	MPI 11

System DFT: 4.5 mils

MPI REX 6.3L-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 6	MPI 119	MPI 119

System DFT: 4.5 mils

2. Waterborne Solid Color Stain

MPI REX 6.3K (Stain)

Spot Primer:	Intermediate:	Topcoat:
MPI 6	MPI 16	MPI 16

System DFT: 4 mils

D. New, Uncoated wood siding:

1. Semi-Transparent Stain

MPI EXT 6.3D

Spot Primer:	Intermediate:	Topcoat:
N/A	MPI 13	MPI 13

System DFT: N/A

E. Existing, previously stained wood siding:

1. Latex

MPI REX 6.2K-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 5	MPI 10	MPI 10

System DFT: 4.5 mils

MPI REX 6.2K-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 5	MPI 11	MPI 11

System DFT: 4.5 mils

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

F. Existing Uncoated or previously semitransparent stained wood siding:

1. Semi-Transparent Stain
   MPI REX 6.3D
   Spot Primer: Intermediate: Topcoat:
   N/A MPI 13 MPI 13
   System DFT: Per Manufacturer

G. Wood: Steps, platforms, floors of open porches, and with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Latex Floor Paint
   MPI EXT 6.5A-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 5 MPI 60 +NSA MPI 60 +NSA
   System DFT: 4.5 mils

   MPI EXT 6.5A-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 5 MPI 68 NSA MPI 68 +NSA
   System DFT: 4.5 mils

2. Alkyd Floor Paint
   MPI EXT 6.5B-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 59 MPI 59 +NSA MPI 59 +NSA
   System DFT: 5 mils

   MPI EXT 6.5B-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 27 MPI 27 +NSA MPI 27 +NSA
   System DFT: 5 mils

DIVISION 9: EXTERIOR STUCCO PAINT TABLE

A. New and Existing stucco:

1. Latex
   New; MPI EXT 9.1A-G1 (Flat) / Existing; MPI REX 9.1A-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 10 MPI 10 MPI 10
   System DFT: 4.5 mils

   New; MPI EXT 9.1A-G5 (Semigloss) / Existing; MPI REX 9.1A-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 11 MPI 11 MPI 11
   System DFT: 4.5 mils

   New; MPI EXT 9.1A-G6 (Gloss) / Existing; MPI REX 9.1A-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 119 MPI 119 MPI 119
   System DFT: 4.5 mils

   Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. On existing stucco, apply primer based on surface

DIVISION 9: EXTERIOR STUCCO PAINT TABLE
condition.

B. New and Existing stucco, elastomeric system:

1. Elastomeric Coating
New; MPI EXT 9.1C / Existing; MPI REX 9.1C
Primer: Intermediate: Topcoat:
N/A MPI 113 MPI 113
System DFT: 16 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions).

NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 16 mils .

DIVISION 10: EXTERIOR CLOTH COVERINGS AND BITUMINOUS COATED SURFACES PAINT TABLE

A. Insulation and surfaces of insulation coverings (canvas, cloth, paper): (Interior and Exterior Applications)

1. Latex
MPI EXT 10.1A-G1 (Flat)
Primer: Intermediate: Topcoat:
N/A MPI 10 MPI 10
System DFT: 3.2 mils

MPI EXT 10.1A-G5 (Semigloss)
Primer: Intermediate: Topcoat:
N/A MPI 11 MPI 11
System DFT: 3.2 mils

MPI EXT 10.1A-G6 (Gloss)
Primer: Intermediate: Topcoat:
N/A MPI 119 MPI 119
System DFT: 3.2 mils

Topcoat: Coating to match adjacent surfaces.

3.15.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New and uncoated existing and Existing, previously painted Concrete, vertical surfaces, not specified otherwise:

1. Latex
New; MPI INT 3.1A-G2 (Flat) / Existing; MPI RIN 3.1A-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 50 MPI 44 MPI 44
System DFT: 4 mils

New; MPI INT 3.1A-G3 (Eggshell) / Existing; MPI RIN 3.1A-G3 (Eggshell)
Primer: Intermediate: Topcoat:

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

MPI 50	MPI 52	MPI 52
System DFT: 4 mils		

New; MPI INT 3.1A-G5 (Semigloss) / Existing; MPI RIN 3.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54
System DFT: 4 mils		

2. High Performance Architectural Latex

New; MPI INT 3.1C-G2 (Flat) / Existing; MPI RIN 3.1J-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 138	MPI 138
System DFT: 4 mils		

New; MPI INT 3.1C-G3 (Eggshell) / Existing; MPI RIN 3.1J-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 139	MPI 139
System DFT: 4 mils		

New; MPI INT 3.1C-G4 (satin)/ Existing; MPI RIN 3.1J-G4

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 140	MPI 140
System DFT: 4 mils		

New; MPI INT 3.1C-G5 (Semigloss) / Existing; MPI RIN 3.1J-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 141	MPI 141
System DFT: 4 mils		

3. Institutional Low Odor / Low VOC Latex

New; MPI INT 3.1M-G2 (Flat) / Existing; MPI RIN 3.1L-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 144	MPI 144
System DFT: 4 mils		

New; MPI INT 3.1M-G3 (Eggshell) / Existing; MPI RIN 3.1L-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 145	MPI 145
System DFT: 4 mils		

New; MPI INT 3.1M-G4 (satin)/ Existing; MPI RIN 3.1L-G4

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146
System DFT: 4 mils		

New; MPI INT 3.1M-G5 (Semigloss) / Existing; MPI RIN 3.1L-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147
System DFT: 4 mils		

B. Concrete ceilings, uncoated:

1. Latex Aggregate

MPI INT 3.1N

Primer:	Intermediate:	Topcoat:
N/A	N/A	MPI 42
System DFT: Per Manufacturer		

DIVISION 3: INTERIOR CONCRETE PAINT TABLE
Texture - Fine, Medium, Coarse. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions.
Topcoat: Coating to match adjacent surfaces.

C. New and uncoated existing and Existing, previously painted Concrete in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high-humidity areas not otherwise specified except floors:

1. Waterborne Light Industrial Coating
New; MPI INT 3.1L-G3(Eggshell) / Existing; MPI RIN 3.1C-G3(Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 151	MPI 151	MPI 151

System DFT: 4.8 mils

New; MPI INT 3.1L-G5(Semigloss) / Existing; MPI RIN 3.1C-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 153	MPI 153	MPI 153

System DFT: 4.8 mils

New; MPI INT 3.1L-G6(Gloss) / Existing; MPI RIN 3.1C-G6(Gloss)

Primer:	Intermediate:	Topcoat:
MPI 154	MPI 154	MPI 154

System DFT: 4.8 mils

2. Alkyd
New; MPI INT 3.1D-G3 (Eggshell) / Existing; RIN 3.1D-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 51	MPI 51

System DFT: 4.5 mils

MPI INT 3.1D-G5 (Semigloss) / Existing; RIN 3.1D-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

System DFT: 4.5 mils

MPI INT 3.1D-G6 (Gloss) / Existing; RIN 3.1D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 48	MPI 48

System DFT: 4.5 mils

3. Epoxy
New; MPI INT 3.1F-G6 (Gloss) / Existing; MPI RIN 3.1E-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

System DFT: 4 mils

Note: Primer may be reduced for penetration per manufacturer's instructions.

D. New and uncoated existing and Existing, previously painted concrete walls and bottom of swimming pools:

1. Chlorinated Rubber

Primer:	Intermediate:	Topcoat:
SSPC Paint 18	SSPC Paint 18	SSPC Paint 18

System DFT: Per Manufacturer

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

Note: Primer may be reduced for penetration per manufacturer's instructions.

2. Epoxy
New; MPI INT 3.1F / Existing; MPI RIN 3.1E

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

System DFT: 4 mils

Note: Primer may be reduced for penetration per manufacturer's instructions.

E. New and uncoated existing and Existing, previously painted concrete floors in following areas:

1. Latex Floor Paint
New; MPI INT 3.2A-G2 (Flat) / Existing; MPI RIN 3.2A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 60	MPI 60	MPI 60

System DFT: 5 mils

2. Alkyd Floor Paint
New; MPI INT 3.2B-G2 (Flat) / Existing; MPI RIN 3.2B-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 59	MPI 59	MPI 59

System DFT: 5 mils

3. Epoxy
New; MPI INT 3.2C-G6 (Gloss) / Existing; MPI RIN 3.2C-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

System DFT: 5 mils

Note: Primer may be reduced for penetration per manufacturer's instructions.

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New and uncoated Existing Concrete masonry:

1. High Performance Architectural Latex
MPI INT 4.2D-G2 (Flat)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 138	MPI 138

System DFT: 11 mils

MPI INT 4.2D-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 139	MPI 139

System DFT: 11 mils

MPI INT 4.2D-G4 (Satin)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 140	MPI 140

System DFT: 11 mils

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

MPI INT 4.2D-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 141	MPI 141

System DFT: 11 mils

Fill all holes in masonry surface

2. Institutional Low Odor / Low VOC Latex

New; MPI INT 4.2E-G2 (Flat)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 144	MPI 144

System DFT: 4 mils

New; MPI INT 4.2E-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 145	MPI 145

System DFT: 4 mils

New; MPI INT 4.2E-G4 (Satin)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 146	MPI 146

System DFT: 4 mils

New; MPI INT 4.2E-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 147	MPI 147

System DFT: 4 mils

B. Existing, previously painted Concrete masonry:

1. High Performance Architectural Latex

MPI RIN 4.2K-G2 (Flat)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 138	MPI 138

System DFT: 4.5 mils

MPI RIN 4.2K-G3 (Eggshell)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 139	MPI 139

System DFT: 4.5 mils

MPI RIN 4.2K-G4

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 140	MPI 140

System DFT: 4.5 mils

MPI RIN 4.2K-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 141	MPI 141

System DFT: 4.5 mils

2. Institutional Low Odor / Low VOC Latex

Existing; MPI RIN 4.2L-G2 (Flat)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 144	MPI 144

System DFT: 4 mils

Existing; MPI RIN 4.2L-G3 (Eggshell)

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 145	MPI 145

System DFT: 4 mils

Existing; MPI RIN 4.2L-G4 (Satin)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146

System DFT: 4 mils

Existing; MPI RIN 4.2L-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147

System DFT: 4 mils

C. New and uncoated Existing Concrete masonry units in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas unless otherwise specified:

1. Waterborne Light Industrial Coating

MPI INT 4.2K-G3(Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 151	MPI 151

System DFT: 11 mils

MPI INT 4.2K-G5(Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 153	MPI 153

System DFT: 11 mils

MPI INT 4.2K-G6(Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 154	MPI 154

System DFT: 11 mils

Fill all holes in masonry surface

2. Alkyd

MPI INT 4.2N-G3 (Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 51	MPI 51

System DFT: 12 mils

MPI INT 4.2N-G5 (Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 47	MPI 47

System DFT: 12 mils

MPI INT 4.2N-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 48	MPI 48

System DFT: 12 mils

Fill all holes in masonry surface

3. Epoxy

MPI INT 4.2G-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

MPI 116	N/A	MPI 77	MPI 77

System DFT: 10 mils

Fill all holes in masonry surface

D. Existing, previously painted, concrete masonry units in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas unless otherwise specified:

1. Waterborne Light Industrial Coating

MPI RIN 4.2G-G3(Eggshell)

Spot Primer:	Intermediate:	Topcoat:
MPI 151	MPI 151	MPI 151

System DFT: 4.5 mils

MPI RIN 4.2G-G5(Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 153	MPI 153	MPI 153

System DFT: 4.5 mils

MPI RIN 4.2G-G6(Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 154	MPI 154	MPI 154

System DFT: 4.5 mils

2. Alkyd

MPI RIN 4.2C-G3 (Eggshell)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 51	MPI 51

System DFT: 4.5 mils

MPI RIN 4.2C-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

System DFT: 4.5 mils

MPI RIN 4.2C-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 48	MPI 48

System DFT: 4.5 mils

3. Epoxy

MPI RIN 4.2D-G6 (Gloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

System DFT: 5 mils

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

INTERIOR STEEL / FERROUS SURFACES

1. High Performance Architectural Latex
   MPI INT 5.1R-G2 (Flat)
   Primer: MPI 79 | Intermediate: MPI 138 | Topcoat: MPI 138
   System DFT: 5 mils

   MPI INT 5.1R-G3 (Eggshell)
   Primer: MPI 79 | Intermediate: MPI 139 | Topcoat: MPI 139
   System DFT: 5 mils

   MPI INT 5.1R-G5 (Semigloss)
   Primer: MPI 79 | Intermediate: MPI 141 | Topcoat: MPI 141
   System DFT: 5 mils

2. Alkyd
   MPI INT 5.1E-G2 (Flat)
   Primer: MPI 79 | Intermediate: MPI 49 | Topcoat: MPI 49
   System DFT: 5.25 mils

   MPI INT 5.1E-G3 (Eggshell)
   Primer: MPI 79 | Intermediate: MPI 51 | Topcoat: MPI 51
   System DFT: 5.25 mils

   MPI INT 5.1E-G5 (Semigloss)
   Primer: MPI 79 | Intermediate: MPI 47 | Topcoat: MPI 47
   System DFT: 5.25 mils

   MPI INT 5.1E-G6 (Gloss)
   Primer: MPI 79 | Intermediate: MPI 48 | Topcoat: MPI 48
   System DFT: 5.25 mils

B. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Alkyd Floor Paint
   MPI INT 5.1U-G6 (Gloss)
   Primer: MPI 79 | Intermediate: MPI 27 | Topcoat: MPI 27 (+NSA)
   System DFT: 5.25 mils

2. Epoxy
   MPI INT 5.1L-G6 (Gloss)
   Primer: MPI 101 | Intermediate: MPI 77 | Topcoat: MPI 77 (+NSA)
   System DFT: 5.25 mils

C. Metal in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high-humidity areas not otherwise specified except floors, hot metal surfaces, and new prefinished

INTERIOR STEEL / FERROUS SURFACES
equipment:

1. Alkyd
MPI INT 5.1E-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 79 MPI 51 MPI 51
System DFT: 5.25 mils

MPI INT 5.1E-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 47 MPI 47
System DFT: 5.25 mils

MPI INT 5.1E-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 48 MPI 48
System DFT: 5.25 mils

2. Alkyd
MPI INT 5.1T-G3 (Eggshell) For hand tool cleaning
Primer: Intermediate: Topcoat:
MPI 23 MPI 51 MPI 51
System DFT: 5.25 mils

MPI INT 5.1T-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 23 MPI 47 MPI 47
System DFT: 5.25 mils

MPI INT 5.1T-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 23 MPI 48 MPI 48
System DFT: 5.25 mils

D. Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surfaces as follows:

1. Aluminum Paint
MPI INT 5.1M
Primer: Intermediate: Topcoat:
MPI 79 MPI 1 MPI 1
System DFT: 4.25 mils

E. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. High Performance Architectural Latex
MPI INT 5.4F-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 95 MPI 138 MPI 138
System DFT: 5 mils

MPI INT 5.4F-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 95 MPI 139 MPI 139
System DFT: 5 mils

INTERIOR STEEL / FERROUS SURFACES

MPI INT 5.4F-G4 (Satin)
Primer: Intermediate: Topcoat:
MPI 95 MPI 140 MPI 140
System DFT: 5 mils

MPI INT 5.4F-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 141 MPI 141
System DFT: 5 mils

2. Alkyd
MPI INT 5.4J-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 95 MPI 49 MPI 49
System DFT: 5 mils

MPI INT 5.4J-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 95 MPI 51 MPI 51
System DFT: 5 mils

MPI INT 5.4J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 47 MPI 47
System DFT: 5 mils

MPI INT 5.4J-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 48 MPI 48
System DFT: 5 mils

F. Hot metal surfaces including smokestacks subject to temperatures up to 205 degrees C (400 degrees F):

1. Heat Resistant Enamel
MPI INT 5.2A
Primer: Intermediate: Topcoat:
MPI 21 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

G. Ferrous metal subject to high temperature, up to 400 degrees C (750 degrees F):

1. Inorganic Zinc Rich Coating
MPI INT 5.2C
Primer: Intermediate: Topcoat:
MPI 19 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

2. Heat Resistant Aluminum Paint
MPI INT 5.2B (Aluminum Finish)
Primer: Intermediate: Topcoat:
MPI 2 Surface preparation and number of coats per manufacturer's instructions.

INTERIOR STEEL / FERROUS SURFACES
System DFT: Per Manufacturer

H. New surfaces and Existing surfaces made bare cleaning to SSPC SP 10 subject to temperatures up to 593 degrees C (1100 degrees F):

1. High Heat Resistant Coating
MPI INT 5.2D
Primer: Intermediate: Topcoat:
MPI 22 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New and Existing, uncoated Wood and plywood not otherwise specified:

1. High Performance Architectural Latex
MPI INT 6.4S-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 39 MPI 139 MPI 139
System DFT: 4.5 mils

MPI INT 6.4S-G4 (Satin)
Primer: Intermediate: Topcoat:
MPI 39 MPI 140 MPI 140
System DFT: 4.5 mils

MPI INT 6.4S-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 39 MPI 141 MPI 141
System DFT: 4.5 mils

2. Alkyd
MPI INT 6.4B-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 45 MPI 51 MPI 51
System DFT: 4.5 mils

MPI INT 6.4B-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 45 MPI 47 MPI 47
System DFT: 4.5 mils

MPI INT 6.4B-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 45 MPI 48 MPI 48
System DFT: 4.5 mils

3. Institutional Low Odor / Low VOC Latex
New; MPI INT 6.3V-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 39 MPI 144 MPI 144
System DFT: 4 mils

New; MPI INT 6.3V-G3 (Eggshell)
Primer: Intermediate: Topcoat:

DIVISION 6: INTERIOR WOOD PAINT TABLE

MPI 39	MPI 145	MPI 145

System DFT: 4 mils

New; MPI INT 6.3V-G4

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 146	MPI 146

System DFT: 4 mils

New; MPI INT 6.3V-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 147	MPI 147

System DFT: 4 mils

B. Existing, previously painted Wood and plywood not otherwise specified:

1. High Performance Architectural Latex

MPI RIN 6.4B-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 139	MPI 139

System DFT: 4.5 mils

MPI RIN 6.4B-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 140	MPI 140

System DFT: 4.5 mils

MPI RIN 6.4B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 141	MPI 141

System DFT: 4.5 mils

2. Alkyd

MPI RIN 6.4C-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 51	MPI 51

System DFT: 4.5 mils

MPI RIN 6.4C-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 47	MPI 47

System DFT: 4.5 mils

MPI RIN 6.4C-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 48	MPI 48

System DFT: 4.5 mils

3. Institutional Low Odor / Low VOC Latex

Existing; MPI RIN 6.4D-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 144	MPI 144

System DFT: 4 mils

Existing; MPI RIN 6.4D-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 145	MPI 145

System DFT: 4 mils

DIVISION 6: INTERIOR WOOD PAINT TABLE

Existing; MPI RIN 6.4D-G4

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 146	MPI 146

System DFT: 4 mils

Existing; MPI RIN 6.4D-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 147	MPI 147

System DFT: 4 mils

C. New and Existing, previously finished or stained Wood and Plywood, except floors; natural finish or stained:

1. Natural finish, oil-modified polyurethane

New; MPI INT 6.4J-G4 / Existing; MPI RIN 6.4L-G4

Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

System DFT: 4 mils

New; MPI INT 6.4J-G6 (Gloss) / Existing; MPI RIN 6.4L-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 56	MPI 56	MPI 56

System DFT: 4 mils

2. Stained, oil-modified polyurethane

New; MPI INT 6.4E-G4 / Existing; MPI RIN 6.4G-G4

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 57	MPI 57	MPI 57

System DFT: 4 mils

New; MPI INT 6.4E-G6 (Gloss) / Existing; MPI RIN 6.4G-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 56	MPI 56	MPI 56

System DFT: 4 mils

3. Stained, Moisture Cured Urethane

New; MPI INT 6.4V-G2 (Flat) / Existing; MPI RIN 6.4V-G2 (Flat)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 71	MPI 71	MPI 71

System DFT: 4 mils

New; MPI INT 6.4V-G6 (Gloss) / Existing; MPI RIN 6.4V-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 31	MPI 31	MPI 31

System DFT: 4 mils

D. New and Existing, previously finished or stained Wood Floors; Natural finish or stained:

1. Natural finish, oil-modified polyurethane

New; MPI INT 6.5C-G6 (Gloss) / Existing; MPI RIN 6.5C-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 56	MPI 56	MPI 56

System DFT: 4 mils

2. Natural finish, Moisture Cured Polyurethane

New; MPI INT 6.5K-G6 (Gloss) / Existing; MPI RIN 6.5D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:

DIVISION 6: INTERIOR WOOD PAINT TABLE

MPI 31 MPI 31 MPI 31
System DFT: 4 mils

3. Stained, oil-modified polyurethane
New; MPI INT 6.5B-G6 (Gloss) / Existing; MPI RIN 6.5B-G6 (Gloss)
Stain: Primer: Intermediate: Topcoat:
MPI 90 MPI 56 MPI 56 MPI 56
System DFT: 4 mils

4. Stained, Moisture Cured Polyurethane
New; MPI INT 6.5J-G6 (Gloss) / Existing; MPI RIN 6.5L-G6 (Gloss)
Stain: Primer: Intermediate: Topcoat:
MPI 90 MPI 31 MPI 31 MPI 31
System DFT: 4 mils

E. New and Existing, previously coated Wood floors; pigmented finish:

1. Latex Floor Paint
New; MPI INT 6.5G-G2 (Flat) / Existing; MPI RIN 6.5J-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 45 MPI 60 MPI 60
System DFT: 4.5 mils

New; MPI INT 6.5G-G6 (Gloss) / Existing; MPI RIN 6.5J-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 45 MPI 68 MPI 68
System DFT: 4.5 mils

2. Alkyd Floor Paint
New; MPI INT 6.5A-G2 (Flat) / Existing; MPI RIN 6.5A-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 59 MPI 59 MPI 59
System DFT: 4.5 mils

New; MPI INT 6.5A-G6 (Gloss) / Existing; MPI RIN 6.5A-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 27 MPI 27 MPI 27
System DFT: 4.5 mils

F. New and Existing, uncoated wood surfaces in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas not otherwise specified.:

1. As specified in Section 09 96 59 HIGH-BUILD GLAZE COATINGS.

2. Waterborne Light Industrial
MPI INT 6.3P-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 45 MPI 153 MPI 153
System DFT: 4.5 mils

MPI INT 6.3P-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 45 MPI 154 MPI 154
System DFT: 4.5 mils

3. Alkyd

DIVISION 6: INTERIOR WOOD PAINT TABLE

MPI INT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47

System DFT: 4.5 mils

MPI INT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48

System DFT: 4.5 mils

G. Existing, previously painted wood surfaces in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas not otherwise specified:

1. As specified in Section 09 96 59 HIGH-BUILD GLAZE COATINGS.

2. Waterborne Light Industrial Coating

MPI RIN 6.3P-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 153	MPI 153

System DFT: 4.5 mils

MPI RIN 6.3P-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 154	MPI 154

System DFT: 4.5 mils

3. Alkyd

MPI RIN 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 47	MPI 47

System DFT: 4.5 mils

MPI RIN 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 48	MPI 48

System DFT: 4.5 mils

H. New and Existing, previously finished or stained Wood Doors; Natural Finish or Stained:

1. Natural finish, oil-modified polyurethane

New; MPI INT 6.3K-G4 / Existing; MPI RIN 6.3K-G4

Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

System DFT: 4 mils

New; MPI INT 6.3K-G6 (Gloss) / Existing; MPI RIN 6.3K-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 56	MPI 56	MPI 56

System DFT: 4 mils

Note: Sand between all coats per manufacturers recommendations.

2. Stained, oil-modified polyurethane

New; MPI INT 6.3E-G4 / Existing; MPI RIN 6.3E-G4

Stain:	Primer:	Intermediate:	Topcoat:

DIVISION 6: INTERIOR WOOD PAINT TABLE

MPI 90	MPI 57	MPI 57	MPI 57

System DFT: 4 mils

New; MPI INT 6.3E-G6 (Gloss) / Existing; MPI RIN 6.3E-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 56	MPI 56	MPI 56

System DFT: 4 mils

Note: Sand between all coats per manufacturers recommendations.

3. Stained, Moisture Cured Urethane

New; MPI INT 6.4V-G2 (Flat) / Existing; MPI RIN 6.4V-G2 (Flat)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 71	MPI 71	MPI 71

System DFT: 4 mils

New; MPI INT 6.4V-G6 (Gloss) / Existing; MPI RIN 6.4V-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 31	MPI 31	MPI 31

System DFT: 4 mils

Note: Sand between all coats per manufacturers recommendations.

I. New and Existing, uncoated Wood Doors; Pigmented finish:

1. Alkyd

New; MPI INT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47

System DFT: 4.5 mils

New; MPI INT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48

System DFT: 4.5 mils

Note: Sand between all coats per manufacturers recommendations.

2. Pigmented Polyurethane

New; MPI INT 6.1E-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 72	MPI 72	MPI 72

System DFT: 4.5 mils

Note: Sand between all coats per manufacturers recommendations.

J. Existing, previously painted Wood Doors; Pigmented finish:

1. Alkyd

New; MPI RIN 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 47	MPI 47

System DFT: 4.5 mils

New; MPI RIN 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 48	MPI 48

System DFT: 4.5 mils

DIVISION 6: INTERIOR WOOD PAINT TABLE

Note: Sand between all coats per manufacturers recommendations.

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New and Existing, previously painted, Plaster and Wallboard not otherwise specified:

1. Latex

New; MPI INT 9.2A-G2 (Flat) / Existing; RIN 9.2A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 44	MPI 44

System DFT: 4 mils

New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 4 mils

New; MPI INT 9.2A-G5 (Semigloss) / Existing; RIN 9.2A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 4 mils

2. High Performance Architectural Latex - High Traffic Areas

New; MPI INT 9.2B-G2 (Flat) / Existing; MPI RIN 9.2B-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 138	MPI 138

System DFT: 4 mils

New; MPI INT 9.2B-G3 (Eggshell) / Existing; MPI RIN 9.2B-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 139	MPI 139

System DFT: 4 mils

New; MPI INT 9.2B-G5 (Semigloss) / Existing; MPI RIN 9.2B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 141	MPI 141

System DFT: 4 mils

3. Institutional Low Odor / Low VOC Latex

New; MPI INT 9.2M-G2 (Flat) / Existing; MPI RIN 9.2M-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 144	MPI 144

System DFT: 4 mils

New; MPI INT 9.2M-G3 (Eggshell) / Existing; MPI RIN 9.2M-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 145	MPI 145

System DFT: 4 mils

New; MPI INT 9.2M-G4 (Satin) / Existing; MPI RIN 9.2M-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146

System DFT: 4 mils

New; MPI INT 9.2M-G5 (Semigloss) / Existing; MPI RIN 9.2M-G5 (Semigloss)

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147

System DFT: 4 mils

B. New and Existing, previously painted, Plaster and Wallboard in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas not otherwise specified.:

1. Waterborne Light Industrial Coating
   New; MPI INT 9.2L-G5(Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 153	MPI 153

   System DFT: 4 mils

2. Alkyd
   New; MPI INT 9.2C-G5 (Semigloss) / Existing; MPI RIN 9.2C-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

   System DFT: 4 mils

3. Epoxy
   New; MPI INT 9.2E-G6 (Gloss) / Existing; MPI RIN 9.2D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 77	MPI 77

   System DFT: 4 mils

-- End of Section --

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

IEEE/ASTM SI 10	(2002) American National Standard for Use of the International System of Units (SI): The Modern Metric System

MASTER PAINTERS INSTITUTE (MPI)

MPI ASM	(2004) Architectural Painting Specification Manual

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 7	(2007) Brush-Off Blast Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

QPL-TNT-AP-28	(2004) Paint, Aluminum, Heat Resisting (1200 Degrees F)

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment and Fixture List in accordance with paragraph entitled, "Delivery, Handling and Storage," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items including manufacturer's name and identification. Data shall include detailed analysis of each special coating material required for the project, with all the coating constituents measured as percentages of the total weight of the coating. Manufacturer's data concerning application, thinning, and average coverage per gallon shall be included.

Heat-Resistant Coatings
Epoxy Coatings

Polyurethane Coatings
Chlorinated-Rubber Coatings

SD-04 Samples

Submit sample Color Chips in accordance with paragraph entitled, "Delivery, Handling and Storage," of this section.

SD-07 Certificates

Submit certificates for following items showing conformance with the referenced standards contained in this section.

Heat-Resistant Coatings
Epoxy Coatings
Polyurethane Coatings
Chlorinated-Rubber Coatings

1.3 DELIVERY, HANDLING AND STORAGE

Special coating materials must be delivered to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Special coating materials must be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Solvents, thinners, and equipment cleaners must be stored with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 45 degrees F.

Submit Material, Equipment and Fixture List consisting of a list of proposed equipment to be used in performance of construction work.

Submit three color chips 3 inch by 4 inch or manufacture pull-down of each finish color and gloss as scheduled.

1.4 FIELD TESTS

Government may take dry-film tests from time to time on finished surfaces. Apply additional coatings to surfaces where there is less than the minimum specified dry-film thickness.

1.5 PROTECTIONS AND SAFETY PRECAUTIONS

Protect adjacent materials and equipment against damage from spillage, dripping, and spatter of coating materials. Building materials and equipment must be left clean and with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

Provide forced ventilation for interior spaces during application and drying of coatings to prevent the buildup of toxic or explosive concentrations of solvent vapors.

Provide fire extinguishers of the required quantity and correct type to combat flammable liquid fires.

Dispose of rags that are used to wipe up coating materials, solvents, and thinners by drenching them with water and placing in a covered metal container.

1.6 QUALITY ASSURANCE

Comply with Master Painters Institute (MPI) Standards indicated and listed in "MPI Approved Products List." Comply with the requirements in "MPI Architectural Painting Specification Manual" before any project is started.

PART 2 PRODUCTS

2.1 HEAT-RESISTANT COATINGS

2.1.1 Category 1, 50 to 400 Degrees F

Coatings for surface temperatures not exceeding 400 degrees F must be alkyd resin-based material. Apply a minimum two coats of coating with a dry-film thickness of a minimum 4 mils.

First coat must be an epoxy zinc primer conforming to MPI ASM, No. 20 with the resin solids and zinc pigment not less than 80 percent of the total weight of the material.

White and color pigmented finish coats must be an alkyd resin-based material with the resin solids and pigments not less than 85 percent of the total weight of the material. Pigments must be heat-stable materials, formulated to colors as scheduled.

Black-pigmented finish coats must be an alkyd resin, carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Aluminum pigmented finish coats must be an alkyd resin-based material with resin solids and pigments not less than 50 percent of the total weight of the material.

2.1.2 Category 2, 300 to 600 Degrees F

Coatings for surface temperatures not exceedingmust be based on modified silicone and silicone-based resins. Coatings must be applied in not less than two coats with a dry-film thickness of not less than 3 mils.

Provide a silicone-based resin zinc-pigmented material with the resin solids and zinc pigment for the first coat not less than 80 percent of the total weight of the material.

Color pigmented finish coats must be silicone-based resin material with the resin solids and pigments not less than 80 percent of the total weight of the material. Pigments must be heat-stable materials, formulated to colors as scheduled.

Black-pigmented finish coat must be a silicone-based resin carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Aluminum-pigmented finish coats must be modified, silicone-based-resin material with the resin solids and pigments not less than 50 percent of the total weight of the material.

2.1.3 Category 3, 600 to 800 Degrees F

Provide a modified silicone or a silicone-based material of coating for surface temperatures not exceeding 800 degrees F. Apply a minimum two coats with a dry-film thickness of a minimum.

Provide a silicone-based resin, zinc-pigmented material first coat with the resin solids and zinc pigment for the first coat not less than 80 percent of the total weight of the material.

Black-pigmented finish coat must be a silicone-based resin, carbon-black pigmented material with resin solids and pigments not less than 50 percent of the total weight of the material.

Aluminum-pigmented finish coat must be a modified, silicone-based-resin material with the resin solids and pigments not less than 50 percent of the total weight of the material.

2.1.4 Category 4, 800 to 1,200 Degrees F

Coatings for surface temperatures not exceeding 1,200 degrees F must be an aluminum-pigmented, silicone-resin-based material conforming to QPL-TNT-AP-28, as modified.

Apply a minimum two coats with a dry-film thickness of a minimum 2 mils.

Coating pigment must contain a minimum of 28 percent aluminum based on the total weight of the material. Vehicle must contain a minimum of 22 percent silicone resin and a maximum of 49 percent of volatile thinners and driers based on the total weight of the material.

2.2 EPOXY COATINGS

2.2.1 General

Conform to MPI ASM, No. 116 for epoxy coatings and epoxy block filler, as modified.

Vehicle resins for finish coats must be based on a polyamide-cured, epoxy-resin material. Apply finish coats with a dry-film thickness of not less than 4 mils per coat. Finish color and gloss must be as indicated.

2.2.2 Concrete Surface Coatings

Apply a epoxy coating system in conformance with MPI ASM, No. 77, water-based epoxy coating system in conformance with MPI ASM, No. 115 for vertical concrete surfaces. Apply an epoxy slip-resistant deck coating system in conformance with MPI ASM, No. 82. Prime coat must fill concrete surface pores with a total dry-film thickness of not less than 2 mils.

2.2.3 Masonry Surfaces Coatings

Apply a Water-Based, Light-Industrial Coating System in conformance with MPI ASM, No. 110, Epoxy Coating System in conformance with MPI ASM, No. 77, Water-Based Epoxy Coating System in conformance with MPI ASM, No. 115, Polyurethane, Pigmented, Over Epoxy Coating System in conformance with MPI ASM, No. 72. Block filler must fill surface pores with a total dry-film thickness of not less than 7 mils.

2.2.4 Ferrous and Galvanized Metal Surface Coatings

Coatings on ferrous and galvanized metal surfaces must be a prime coat and not less than two finish coats. Comply with MPI ASM, No. 101 for an epoxy zinc primer with a metallic-zinc pigment for the substrate to be coated and the end use of the coated surface. Resin solids and zinc pigment must not be less than 80 percent of the total weight of the coating material. Apply prime coat with a total dry-film thickness of not less than 4 mils. Provide an epoxy-based finished coat as specified.

2.2.5 Aluminum Surface Coatings

Apply an Epoxy Coating System in conformance with MPI ASM, No. 80 and MPI ASM, No. 77. Apply prime coat with a total dry-film thickness of not less than 4 mils.

2.3 POLYURETHANE COATINGS

2.3.1 General

Polyurethane coatings must conform to MPI ASM for each substrates indicated.

Vehicle resins for finish coats must be based on a two-part, prepolymer, catalytic-cured, polyurethane material. Apply catalytic-cured coatings with a total dry-film thickness of not less than 10 mils per coat. Indicate finish color and gloss on the schedules.

2.3.2 Concrete Surface Coatings

Apply a Polyurethane, Pigmented Coating System in conformance with MPI ASM, No. 72 and MPI ASM, No. 80, Polyurethane, Clear, Two-Component Coating System in conformance with MPI ASM, No. 78. Prime coat must fill surface pores with a total dry-film thickness of not less than 2 mils. Finish coats must be a polyurethane-based material as specified.

2.3.3 Masonry Surface Coatings

Apply a Polyurethane, Clear, Two-Component Coating System in conformance with MPI ASM, No. 78. Block filler must fill surface pores with a total dry-film thickness of not less than 7 mils. Finish coats must be a polyurethane-based material as specified.

2.3.4 Ferrous and Galvanized Metal Surface Coatings

Apply a Polyurethane, Pigmented Coating System in conformance with MPI ASM, No. 72, MPI ASM, No. 77, and MPI ASM, No. 101, High-Performance Architectural Latex Coating System in conformance with MPI ASM, No. 134, , No. 138, and MPI ASM, No. 140. Apply prime coat with a dry-film thickness of not less than 2 mils. Finish coats must be a polyurethane-based material as specified.

2.3.5 Aluminum Surface Coatings

Apply a water base, light industrial coating system in conformance with MPI ASM, No. 95, MPI ASM, No. 77 and MPI ASM, No. 80 for epoxy coating, MPI ASM, No. 80 for polyurethane coats on aluminum surfaces. Prime coat must use IEEE/ASTM SI 10 and or a polyurethane-resin material as recommended by the coating manufacturer for the substrate to be coated and

the end use of the coated surfaces. Apply prime coat with a dry-film thickness of not less than 2 mils. Finish coats must be a polyurethane-based material as specified.

2.3.6 Wood Surface Coatings

Apply a pigmented polyurethane coating in conformance with MPI ASM, No. 72, clear polyurethane two-component coating in conformance with MPI ASM, No. 13 and MPI ASM, No. 78. Apply prime coat with a dry-film thickness of not less than 5 mils. Finish coats must be a polyurethane-based material as specified.

2.4 CHLORINATED-RUBBER COATINGS

2.4.1 General

Vehicle resins for finish coats must be based on a modified, chlorinated-rubber, phenolic-resin material. Coating material must contain not less than 20 percent chlorinated rubber resin, based on the total weight of the material. Apply finish coats with a dry-film thickness of not less than 3 mils per coat. Finish coating color must be as indicated.

2.4.2 Concrete Surface Coatings

Apply a minimum three coats on concrete surfaces. Prime coat must be based on a chlorinated-rubber resin material as recommended by the coating manufacturer for the substrate to be coated and the end use of the coated surfaces. Prime coat must fill concrete surface pores with a total film thickness of not less than 2 mils. Finish coats must be chlorinated-rubber-based coatings as specified.

2.4.3 Masonry Surface Coatings

Apply a minimum two finished coats on masonry surfaces must be a masonry block filler. Block filler must be based on an epoxy-ester resin material as recommended by the coating manufacturer for the substrate to be coated and the end use of the coated surface. Block filler must fill surface pores with a total film thickness of not less than 7 mils. Finish coats must be chlorinated-rubber-based coatings as specified.

2.4.4 Ferrous and Galvanized Metal Surface Coatings

Apply a minimum two coats of high performance architectural latex coating in conformance with MPI ASM, No. 79 on ferrous and galvanized metal surfaces. Apply prime coat with a dry-film thickness of not less than 3 mils. Finish coats must be chlorinated rubber-based coatings as specified.

2.4.5 Aluminum Surface Coatings

Apply a minimum three coats of quick drying primer for aluminum surfaces. Prime coat must conform to IEEE/ASTM SI 10 and MPI ASM, No. 80 for aluminum coating system.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Concrete Surfaces

Conform to MPI ASM for substrates indicated. Remove plates, machined surfaces, and similar items already in place that are not to be coated. Provide surface-applied protection before surface preparation and coating where removal is impractical or impossible. After completing coating operations, reinstall items that were removed.

Clean dirt, oil, grease, and incompatible paints from substrates to ensure bonding. Coordination of shop-applied prime coats with high-performance coatings is critical. Remove incompatible primers. Reprime substrate with compatible primers as required to produce coating systems indicated.

3.1.1.1 Concrete Substrates

Remove release agents, curing compounds, efflorescence, and chalk Maximum Moisture Content of concrete is 12 percent. Moisture content must be measured with electronic moisture meter.

Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 inch to 12 inch, 4000 to 10,000 psi.

Comply with SSPC SP 7 (NACE No. 4), "Brush-Off Blast Cleaning" for abrasive cleaning.

3.1.1.2 Clay Masonry Substrates

Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi, 1500 to 4000 psi at 6 inch to 12 inch.

3.1.1.3 Steel Substrates

Remove rust and loose mill scale. Clean using methods recommended in writing by coating manufacturer. Conform to SSPC SP 7 (NACE No. 4) for blast cleaning.

3.1.1.4 Galvanized-Metal Substrates

Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.1.1.5 Aluminum Substrates

Remove surface oxidation.

3.1.1.6 Wood Substrates

Prep substrates by scraping and cleaning small, dry, seasoned knot. Sand surfaces smooth. Apply a thin coat of knot sealer before applying an interior latex-based wood primer. Prime edges, ends, faces, undersides,

and back sides of wood. After priming, fill holes and crevices to the finished surface with putty or plastic wood filler. After finished surface is dry, smooth surface by sanding. For a finished product.

3.2 COATING MATERIAL PREPARATION

3.2.1 General

Mix and prepare coating materials in accordance with the coating manufacturer's printed instructions for the particular material and coat to be applied. Keep materials which are not in actual use in closed containers.

Coating materials that have been mixed with an automatic shaker must be allowed to stand to let air bubbles escape, then given a final hand mixing before application. Stir materials so as to produce a mixture of uniform density. Stir at frequent intervals during application to prevent skinning. Do not stir film which may form on the surface of the material. Remove film and strain, if necessary.

3.2.2 Thinning

Thinning must be done in accordance with coating manufacturer's printed directions for the particular material and coat.

3.2.3 Tinting

Prime and intermediate coats of paint must be a slightly different tint from the finish coat to facilitate identification of each coat. Tinting must be done by the coating manufacturer and clearly identified as to color and coat.

3.3 APPLICATION OF COATING MATERIALS

3.3.1 General

Do not perform exterior painting in damp or rainy weather. Interior painting must not be allowed until the building is enclosed and has thoroughly dried out. Do not allow painting below 50 degrees Fand above 95 degrees F. Painting application must be in accordance with the coating manufacturer's recommendations, and as specified.

Application of coatings must be done by skilled applicators. Apply coatings to clean and properly prepared surfaces. Apply coatings carefully with clean, high-quality application equipment. Allow sufficient time between coats to ensure complete drying and curing. Surfaces must be sanded and dusted between coatings, as required, to produce a surface free of visible defects. High gloss coatings and clear finishes must be lightly sanded between coats to ensure bond of following coats.

Apply coats to the surfaces in an even film. Do not accept cloudiness, spotting, holidays, laps, application marks, runs, sags, and other similar surface imperfections. Remove defective coating applications and recoat as directed.

Coating lines such as wainscots must be sharp, true, and well-defined. Tape may be used to establish coating lines, providing tape is removed before ragging or sawtooth edges form.

Surfaces, including edges, corners, crevices, welds, and other similar changes in surface plane, must receive a dry-film thickness not less than specified.

3.3.2 Brush Application

Brushes must be clean and the proper size and type for high-quality application of the specified coating materials. Slow-dry coatings must be brushed out. Quick-dry coatings must be brushed only enough to spread out evenly.

3.3.3 Roller Application

Roller covers must be clean and of the proper nap length, nap texture, and material for high-quality application of the specified coating materials.

Roller application must be done carefully and must be equivalent in all respects to the same coats applied by high-quality brush application.

3.3.4 Spray Application

Do not allow spray application of coatings.

Spray application equipment must be limited to airless-spray equipment and electrostatic-spray equipment. Equipment must be clean and operated by workmen skilled in high quality application of coating materials.

Spray application of coatings must be limited to finish coats on metal frame works, siding, decking, wire mesh, and other surfaces where hand work would be inferior. Sprayed coatings must be carefully applied and equivalent in all respects to the same coats applied by high quality brush application. Each spray coat must be permitted to cure before the succeeding coat is applied. Do not permit doubling back with application equipment, for the purpose of building up film thickness of two coats in one operation.

Surfaces adjacent to areas to be spray coated shall be covered to prevent damage from overspray, coating rebound, and spray drift.

3.4 ACCEPTANCE PROVISIONS

3.4.1 Repairing

Remove damaged and unacceptable portions of completed work and replace with new work to match adjacent surfaces at no additional cost to the Government.

3.4.2 Cleaning

At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Application equipment must be cleaned promptly and thoroughly with a suitable solvent after each use and stored in a clean, covered, well-ventilated container.

Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

-- End of Section --

SECTION 09 97 13.00 40

STEEL COATINGS

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC A	(2000) Good Painting Practice Steel Structures Painting Manual, Volume 1
SSPC AB 1	(1991; E 2004; E 2007) Mineral and Slag Abrasives
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10	(2007) Near-White Blast Cleaning
SSPC SP 3	(2004; E 2004) Power Tool Cleaning

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted in accordance with paragraph entitled, "General," of this section.

A Safety Plan shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Abrasive Blasting Material
Sealant Compound
Inorganic Zinc
Inhibitive Polyamide Epoxy
Aliphatic Polyurethane

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted in accordance with paragraph entitled, "General," of this section.

Inspection Forms shall be submitted in accordance with paragraph entitled, "Inspection," of this section.

SD-05 Design Data

Mix Designs shall be submitted in accordance with paragraph entitled, "General," of this section.

Inorganic Zinc
Inhibitive Polyamide Epoxy
Aliphatic Polyurethane

SD-06 Test Reports

Inspection reports shall be submitted for protective coating systems in accordance with paragraph entitled, "Inspection," of this section.

SD-07 Certificates

Certificates shall be submitted for following items showing conformance with the referenced standards contained in this section.

Abrasive Blasting Material
Sealant Compound
Inorganic Zinc Coating
Inhibitive Polyamide Epoxy
Aliphatic Polyurethane

SD-08 Manufacturer's Instructions

Manufacturer's instructions shall be submitted for Protective Coatings including details of thinning, mixing, handling, and application.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered in their original, unopened containers bearing the manufacturer's name, shelf-life, product identification, and batch number.

Coatings, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will be protected from exposure to extreme cold or heat, sparks, flame, direct sunlight, or rainfall. Manufacturer's instructions for storage limitations shall be followed.

1.4 GENERAL

A Safety Plan shall be submitted for protective coating systems in accordance with OSHA regulations.

Material, Equipment, and Fixture Lists shall be submitted for

manufacturer's style or catalog numbers, specification and drawing reference numbers and warranty information for the Protective Coatings Systems fabrication site.

Manufacturer's Standard Color Charts shall be submitted showing manufacturer's standard finish colors.

Mix Designs shall be submitted for each type of protective coating including a complete list of ingredients and admixtures. Applicable test report shall verify that the mix has been successfully tested and meets design requirements.

PART 2 PRODUCTS

2.1 ABRASIVE BLASTING MATERIAL

Abrasive blasting materials shall be per SSPC A, Chapter 2.4, and SSPC AB 1.

2.2 SEALANT COMPOUND

Sealant shall be a self-curing, single component, polysulfide-rubber type conforming to ASTM C 920. Sealant shall be gray in color and capable of being applied into the joint with a calking gun.

2.3 PROTECTIVE COATINGS

2.3.1 Coating Systems

The following two coating systems definitions are to be specified for use on the surfaces listed in the Coating Schedule, of this section, and as directed.

Coating System No. 1 shall consist of inorganic zinc only, no top coat unless specified. Inorganic zinc shall be selected from the following listing. Coatings, thinners, and cleaners shall be the product of one manufacturer.

Coating System No. 2 shall consist of inorganic zinc first coat, inhibitive polyamide epoxy intermediate coat, and aliphatic polyurethane finish coat. Coatings shall be selected from the following listing and all coatings, thinners, and cleaners shall be the product of the same manufacturer. Each successive coating shall be of a contrasting color to provide a visual assurance of complete coverage.

Coating System No. 3

COATING SYSTEMS

INORGANIC ZINC	INHIBITIVE POLYAMIDE EPOXY	ALIPHATIC POLYURETHANE	MANUFACTURER
Dimetcote 9	Amercoat 370	Amercoat 450HS	Ameron International 201 N. Berry Street Brea, CA 92621 714/529-1951
Carbo Zinc 11	Carboguard 893	Carbothane 134HG	Carboline Company 350 Hanley Industrial Court

COATING SYSTEMS

INORGANIC ZINC	INHIBITIVE POLYAMIDE EPOXY	ALIPHATIC POLYURETHANE	MANUFACTURER
			St. Louis, MO 63144 800/848-4645 Ext. 2557
Catha-Coat 304V	Devran 201	Devthane 369	ICI-DEVOE 925 Euclid Ave. Cleveland, OH 44115 216/344-8798
347-Y-912	525-333 or 71125P	Imron 333	DuPont Company DuPont Building 1007 Market Street Wilmington, DE 19898 800/441-7515
Porter Zinc 3200	Porter Glaze 4400 High Build	Porterthane 9000 Glass Urethane	Porter Paint Company 400 South 13th Street Louisville, KY 40203 800/332-6270

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 General

Faying surfaces that will become inaccessible after installation shall be abrasive blasted and coated with inorganic zinc only, prior to installation.

Surfaces that are part of slip-critical joints shall be faying abrasive blasted, mechanically cleaned coated with inorganic zinc prior to installation.

Surfaces to be welded shall be left uncoated. Welded areas shall then be masked and touched up.

Prepared surfaces shall be coated within 6 hours after completion of surface preparation and before rusting or recontamination occurs. Surfaces not coated within 6 hours or which show rusting or contamination, regardless of the length of time after preparation, shall be reprepared.

Surface preparation and coating operations shall be sequenced so that freshly applied coatings will not be contaminated by dust or foreign matter.

Surfaces shall be inspected and degreased as required prior to subsequent surface preparation and the application of protective coatings. Degreasing shall be by solvent cleaning, detergent washing, or steam cleaning. SSPC SP 1 shall apply for solvent cleaning.

3.1.2 Abrasive Blasting (AB)

Abrasive blasting shall conform to SSPC SP 10 and SSPC A.

Compressed air used for abrasive blasting shall be free of moisture and oil.

Surfaces not to be blasted are:

Galvanized steel and prefinished surfaces except when specified to be blast-cleaned in the coating schedule

Piston rods and bearing surfaces

A minimum nozzle pressure of 90 pounds per square inch shall be maintained.

Weld slag, weld spatter, and foreign matter shall be removed from surfaces to be coated prior to abrasive blasting using mechanical methods as specified.

Blast cleaning shall achieve a 1-to 2-mil anchor profile as indicated by a surface profile comparator, replica tape, or similar device.

Rust and corrosion shall be removed from pits and depressions.

Abrasive blast aggregate shall not be reused.

All traces of abrasive residue and dust shall be removed from the surface, leaving it clean and dry.

3.1.3 Mechanical Cleaning (MC)

Where mechanical cleaning is specified in the coating schedule for existing surfaces and AB is prohibited, needle scalers or abrasive disks or wheels shall be used in accordance with SSPC SP 3, leaving the surface cleanliness equivalent to near-white metal (SSPC SP 10).

3.2 COATING APPLICATION

3.2.1 General Requirements

Manufacturer's instructions for thinning, mixing, handling, and applying products shall be considered a part of this specification. In the event of conflict between the requirements of this specification and the manufacturer's recommendations, this specification shall take precedence.

Compressed air used for spraying coatings shall be free of moisture and oil.

Each coat of material applied shall be free from runs; sags; blisters; bubbles; mud cracking; variations in color, gloss, and texture; holidays (missed areas); excessive film build; foreign contaminants; and dry overspray.

No coating shall be applied when rain is imminent or when the temperature or humidity is outside the limits recommended by the coating manufacturer.

Surface temperature shall be at least 5 degrees F above the dew point.

Coatings shall be thoroughly worked into all joints, crevices, and open spaces. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure proper coverage and thickness.

Newly coated surfaces shall be adequately protected from damage.

Coatings shall be applied by airless or conventional spray. Airless spraying shall be used for uniform large surface areas. Conventional

spraying shall be used for small areas of intricate configuration and for touchup. During application of inorganic zinc coating, maintain uniform suspension.

3.2.2 Mixing and Application Procedures

Material shall be stirred thoroughly using an instrument that will not induce air into coating.

Mixed material shall be strained through a 30- to 60-mesh screen.

Continuous slow agitation of the material shall be provided during application of inorganic zinc coating, maintain uniform suspension. Continuous rapid agitation shall be avoided.

Material shall be thinned for workability and improved spray characteristics only.

Material shall be applied in even, parallel passes, overlapping 50 percent. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure proper coverage and thickness.

3.2.3 Dry-Film Thickness (DFT)

Coatings shall be applied to the following dry-film thicknesses:

Coating System No. 1:

a. 3 to 6 mils, inorganic zinc, as specified in Coating Schedule.

b. Top coat 2 to 4 mils

c. Second coat, inorganic zinc, 2 to 4 mils

a. Inorganic primer zinc: 2.5 to 4 mils

b. Inhibitive polyamide epoxy, second coat: 2 to 4 mils

c. Aliphatic polyurethane, third coat: 2 to 4 mils, but sufficient to hide previous coat

Coating System No. 3: When dry through (dry to handle), the film thickness shall be checked with a calibrated nondestructive dry-film thickness gage. If less than specified thickness, additional material shall be applied as required. Proper DFT for the inorganic zinc coating shall be obtained in a single application which may consist of multiple passes, while coating is still wet.

3.3 TOUCH-UP

Abrasions that occurred during shipment or erection shall be touched up as follows:

a. Surface preparation and coating application shall conform to the manufacturer's instructions.

b. Inorganic zinc shall be used for touch-up and repair of inorganic zinc and hot-dip galvanizing.

c. Inhibitive polyamide epoxy and aliphatic polyurethane shall be used for touch-up and repair of coating system No. 2.

3.4 SEALANT COMPOUND APPLICATION

For Coating System No. 1, calking shall be accomplished after application and cure of inorganic zinc coating.

For Coating System No. 2, calking shall be accomplished after application and cure of inhibitive epoxy coat and prior to aliphatic polyurethane coat.

Exterior joints shall be calked, including, but not limited to, the following:

a. Perimeter of faying and bearing surfaces of structural members

b. Joints in members between intermittent welds

c. Perimeter of bearing surfaces between floor plates and supporting members (inside, outside, top, and bottom)

d. Stair treads, where joined to channel stringers

e. Openings of 1/2 inch or smaller (Foam filler backup shall be used as required.)

f. Hot-dipped galvanized vent holes

3.5 INSPECTION

On-site work as described herein shall be inspected for compliance with this specification by a NACE (National Association of Corrosion Engineers) Certified Coating Inspector provided by the Contracting Officer, Contractor.

For all protective coatings applied off-site locations, the Contractor shall provide full inspection by NACE Certified Coating Inspector. Inspector shall be present at the pre-work conference to address necessary clarification of inspection and specification requirements. Apparent deviation from the specified requirements or any out of tolerance condition shall be immediately reported to the Contracting Officer for determination of corrective action. Submit inspection reports performed by the Coating Inspector.

Inspection Forms shall be submitted at the pre-work conference which shall be used by the Coating Inspector and forwarded to the Contracting Officer prior to delivery of the coated work to the job site.

3.6 COATING SCHEDULE

SURFACE DESCRIPTION	SURFACE PREPARATION	COATING SYSTEM		FINISH COLOR FOR COATING SYSTEM NO. 2		DRY FILM THICKNESS, PRIMER COAT, MILS	
_____	_____	1	2	red	green	3-5	4-6

-- End of Section --

SECTION 09 97 13.27

EXTERIOR COATING OF STEEL STRUCTURES

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1200	(1994; R 2005) Viscosity by Ford Viscosity Cup
ASTM D 3276	(2007) Painting Inspectors (Metal Substrates)
ASTM D 3925	(2002) Sampling Liquid Paints and Related Pigmented Coatings
ASTM D 4285	(1983; R 2006) Indicating Oil or Water in Compressed Air
ASTM D 7127	(2005) Measurement of Surface Roughness of Abrasive Blast Cleaned Metal Surfaces using a Portable Stylus Instrument

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2000) Quality management systems-Requirements

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC AB 2	(1996; E 2004) Cleanliness of Recycled Ferrous Metallic Abrasive
SSPC AB 3	(2003; E 2004) Newly Manufactured or Re-Manufactured Steel Abrasives
SSPC Guide 12	(1998; E 2004) Guide for Illumination of Industrial Painting Projects
SSPC Guide 6	(2004) Guide for Containing Debris Generated During Paint Removal Operations
SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting

SSPC PA 2	(2004) Measurement of Dry Coating Thickness With Magnetic Gages
SSPC QP 1	(1998; E 2004) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC QP 5	(1999; E 2004) Standard Procedure for Evaluating the Quality of Coating and Lining Inspection Companies
SSPC QS 1	(2004) Standard Procedure for Evaluating a Contractor's Advanced Quality Management System
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10	(2007) Near-White Blast Cleaning
SSPC SP 7	(2007) Brush-Off Blast Cleaning
SSPC SP COM	(2004) Surface Preparation Commentary for Steel and Concrete Substrates
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-22262	(Rev B; Am 2) Abrasive Blasting Media Ship Hull Blast Cleaning
MIL-DTL-24441	(Rev C; Supp 1; INT Am 1) Paint, Epoxy-Polyamide
MIL-DTL-24441/19	(Rev B) Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III
MIL-DTL-24441/31	(Rev A) Paint, Epoxy-Polyamide, White, Formula 152, Type IV
MIL-PRF-85285	(Rev D; Am 1, Am 2) Coating: Polyurethane Aircraft and Support Equipment
MIL-STD-161	(Rev G) Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev B; Am 1) Colors Used in Government Procurement

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910-SUBPART Z	Toxic and Hazardous Substances

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.134	Respiratory Protection
29 CFR 1926.59	Hazard Communication

1.2 DEFINITIONS

Definitions are provided throughout this Section, generally in the paragraph where used, and denoted by capital letters.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-05, Design Data

Containment System

SD-06 Test Reports

Joint Sealant Qualification Test Reports

Coatings Qualification Test Reports

Metallic Abrasive Qualification Test Reports

Coating Sample Test Reports

Abrasive Sample Test Reports

Inspection Report Forms

Daily Inspection Reports

Recycled Metallic Abrasive Field Test Reports (Daily and Weekly)

SD-07 Certificates

Contract Errors, Omissions, and Other Discrepancies

Corrective Action Procedures

Coating Work Plan

Qualifications of Certified Industrial Hygienist (CIH)

Qualifications Of Individuals Performing Abrasive Blasting

Qualifications of Certified Protective Coatings Specialist (PCS)

Qualifications of Coating Inspection Company

Qualifications of QC Specialist Coating Inspector

Qualifications of Testing Laboratory for Coatings

Qualifications of Testing Laboratory for Abrasive

Qualifications of Coating Contractors

Joint Sealant Materials

Coating Materials

Coating System Component Compatibility

Non-metallic Abrasive

Metallic Abrasive

SD-08 Manufacturer's Instructions

Joint Sealant Instructions

Coating System Instructions

SD-11 Closeout Submittals

Disposal of Used Abrasive

Inspection Logbook

1.4 QUALITY ASSURANCE

1.4.1 Contract Errors, Omissions, and Other Discrepancies

Submit all errors, omissions, and other discrepancies in contract documents the Contracting Officer within 30 days of contract award for all work covered in this Section, other than the work that will not be uncovered until a later date. All such discrepancies shall be addressed and resolved, and the Coating Work Plan modified, prior to beginning the Initial and Follow-Up phases of work. Discrepancies that become apparent only after work is uncovered shall be identified at the earliest discoverable time and submitted for resolution. Schedule time (Float) should be built into the project schedule at those points where old work is to be uncovered or where access is not available during the first 30 days after award, to allow for resolution of contract discrepancies.

1.4.2 Corrective Action (CA)

CA shall be included in the Quality Control Plan.

1.4.2.1 Corrective Action Procedures

Develop procedures for determining the root cause of each non-compliance, developing a plan to eliminate the root cause so that the non-compliance does not recur, and following up to ensure that the root cause was eliminated. Develop Corrective Action Request (CAR) forms for initiating CA, and for tracking and documenting each step.

1.4.2.2 Implement Corrective Action

The Contractor shall take action to identify and eliminate the root cause of each non-compliance so as to prevent recurrence. These procedures shall apply to non-compliance in the work, and to non-compliance in the QC System. Corrective actions shall be appropriate to the effects of the

non-compliance encountered. Each CAR shall be serialized, tracked in a Log to completion and acceptance by the Contracting Officer, and retained in project records. The Corrective Action Log, showing status of each CAR, shall be submitted to the Contracting Officer monthly. A CAR may be initiated by either the Contractor or the Contracting Officer. The Contracting Officer must approve each CAR at the root cause identification stage, the plan for elimination stage, and the close out stage after verification that the root cause has been eliminated.

1.4.3 Coating Work Plan

This work plan shall be considered as part of the Quality Control Plan.

Provide procedures for reviewing contract documents immediately after award to identify errors, omissions, and discrepancies so that any such issues can be resolved prior to project planning and development of detailed procedures.

Provide procedures for verification of key processes during Initial Phase to ensure that contract requirements can be met. Key processes shall include surface preparation, coating application and curing, inspection, and documentation, and any other process that might adversely impact orderly progression of work.

Provide procedures for all phases of coating operations, including planned work, rework, repair, inspection, and documentation. Address mobilization and setup, surface preparation, coating application, coating initial cure, tracking and correction of noncompliant work, and demobilization. Coordinate work processes with health and safety plans and confined space entry plans. For each process, provide procedures that include appropriate work instructions, material and equipment requirements, personnel qualifications, controls, and process verification procedures. Provide procedures for inspecting work to verify and document compliance with contract requirements, including inspection forms and checklists, and acceptance and rejection criteria.

Provide procedures for determining the existing surface profile under paint, and procedures for ensuring that the profile is not increased beyond the maximum profile specified herein.

Provide procedures for correcting noncompliant work. Detailed procedures are required in advance to avoid delays in meeting overcoat windows as well as to avoid delays in production. Provide procedures for repairing defects in the coating film, such as runs, drips, sags, holidays, overspray, as well as how to handle correct coating thickness noncompliance, any other areas of repair or rework that might be adversely affected by delays in preparing and approving new procedures.

If a procedure is based on a proposed or approved request for deviation, the deviation shall be referenced. Changes to procedures shall be noted by submittal number and date approved, clearly delineating old requirements and new requirements, so that the records provide a continuous log of requirements and procedures.

1.4.4 Design Data

1.4.4.1 Containment System

Submit complete design drawings and calculations for the scaffolding and

containment system, including an analysis of the loads which will be added to the structure by the containment system and waste materials. A registered engineer shall approve calculations and scaffold system design.

1.4.5 Test Reports

1.4.5.1 Joint Sealant Qualification Test Reports

Submit test results from independent laboratory of representative samples of joint sealant material. Samples must have been tested within the last three years. Submit results as required in paragraph QUALITY ASSURANCE PROVISIONS of ASTM C 920. Note that testing in accordance with QUALITY ASSURANCE PROVISIONS is a pre-qualification requirement.

1.4.5.2 Coatings Qualification Test Reports

Submit test results from independent laboratory of representative samples of each coating material. U.S. Department of Defense laboratories are considered to be independent laboratories for purposes of compliance with "QUALIFICATION INSPECTION" requirements herein. Samples must have been tested within the last three years. Submit results for epoxy materials as required in paragraph QUALIFICATION INSPECTION of MIL-DTL-24441, and as revised by paragraph COATING SYSTEM herein. Submit results for polyurethane materials as required in paragraph QUALIFICATION INSPECTION of MIL-PRF-85285, and as revised by paragraph COATING SYSTEM herein. Note that requirement for QUALIFICATION INSPECTION is a pre-qualification requirement, and involves the same testing required for listing in the Qualified Products List of the respective material. See appropriate Military Specification for specific test requirements.

1.4.5.3 Metallic Abrasive Qualification Test Reports

Submit results for abrasive as required in paragraph 4 REQUIREMENTS of SSPC AB 3. Submit test results from independent laboratory of representative samples of each abrasive to be used on the jobsite. Samples must have been tested within the last three years. Note that this testing is for the purpose of prequalifying the abrasive.

1.4.5.4 Recycled Metallic Abrasive Field Test Reports (Daily and Weekly)

Submit test results from independent laboratory of daily and weekly Quality Control testing required by SSPC AB 2, as modified in paragraph ABRASIVE.

1.4.6 Qualifications

1.4.6.1 Qualifications of Certified Industrial Hygienist (CIH)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party CIH. Submit documentation that hygienist is certified by the American Board of Industrial Hygiene in comprehensive practice, including certification number and date of certification/recertification. Provide evidence of experience with hazards involved in industrial coating application work.

1.4.6.2 Qualifications of Certified Protective Coatings Specialist (PCS)

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party PCS. Submit documentation that specialist is certified by SSPC: The Society for Protective Coatings (SSPC) as a PCS,

including certification number and date of certification/recertification. If the PCS is employed by the same coating inspection company to which the coating inspector is employed, this does not violate the independent third-party requirements. The PCS shall remain certified during the entire project, and the Contracting Officer shall be notified of any change in certification status within 10 days of the change. The PCS shall not be the designated coating inspector.

1.4.6.3 Qualifications of Coating Inspection Company

Submit documentation that the coating inspection company that will be performing all coating inspection functions is certified by SSPC to the requirements of SSPC QP 5 prior to contract award, and shall remain certified while accomplishing any coating inspection functions. The coating inspection company must remain so certified for the duration of the project. If a coating inspection company's certification expires, the firm will not be allowed to perform any inspection functions, and all surface preparation and coating application work must stop, until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in coating inspection company certification status.

1.4.6.4 Qualifications of QC Specialist Coating Inspector

Submit documentation that each coating inspector is employed, and qualified to SSPC QP 5, Level III, by the selected coating inspection company. Each inspector shall remain employed by the coating inspection company while performing any coating inspection functions.

1.4.6.5 Qualifications Of Individuals Performing Abrasive Blasting

Submit name, address, and telephone number of each person that will be performing abrasive blasting. Submit documentation that each blaster is qualified by SSPC to the SSPC C-7 Dry Abrasive Blaster Qualification Program. Each blaster shall remain qualified during the entire period of abrasive blasting, and the Contracting Officer shall be notified of any change in qualification status.

1.4.6.6 Qualifications of Testing Laboratory for Coatings

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that persons performing analyses are qualified.

1.4.6.7 Qualifications of Testing Laboratory for Abrasive

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of abrasive for compliance with specification requirements. Submit documentation that laboratory has experience in testing samples of abrasive for conformance with specifications, and that persons performing analyses are qualified.

1.4.6.8 Qualifications of Coating Contractors

All Contractors and Subcontractors that perform surface preparation or coating application shall be certified to either ISO 9001 or SSPC QP 1 and SSPC QS 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting Contractors and painting Subcontractors must remain so certified for the duration of the project. If a Contractor's or Subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in Contractor certification status.

1.4.6.9 Joint Sealant Materials

Provide manufacturer's certification of conformance to contract requirements.

1.4.6.10 Coating Materials

Provide manufacturer's certification of conformance to contract requirements.

1.4.6.11 Coating System Component Compatibility

Provide certification from each manufacturer of components of the coating system, epoxy primer, epoxy intermediate, and polyurethane topcoat, that the supplied coating material is suitable for use in the specified coating system. Each manufacturer shall identify the specific products, including manufacturer's name, which their product may be used with. The certification shall provide the name of the manufacturer that will provide technical support for the entire system. When all coating materials are manufactured by one manufacturer, this certification is not required.

1.4.6.12 Non-metallic Abrasive

Provide manufacturer's certification that the materials are currently approved by the Naval Sea Systems Command and listed on the Qualified Products Lists (QPL) for the specified materials.

1.4.6.13 Metallic Abrasive

Provide manufacturer's certification of conformance to contract requirements and provide copies of test results.

1.4.7 Protective Coating Specialist (PCS)

The PCS shall be considered a QC Specialist and shall report to the QC Manager, as specified in Section 01 45 02 NAVFAC QUALITY CONTROL. The PCS shall approve all submittals prior to submission to the QC Manager for approval or submission to the government for approval.

1.4.8 Pre-Application Meeting

After approval of submittals but prior to the initiation of coating work, Contractor representatives, including at a minimum, project superintendent and QC manager, paint foreman, coating inspector, and PCS shall have a pre-application coating preparatory meeting. This meeting shall be in

addition to the pre-construction conference. Specific items addressed shall include: corrective action requirements and procedures, coating work plan, safety plan, coordination with other Sections, inspection standards, inspection requirements and tools, test procedures, environmental control system, safety plan, and test logs. Notify Contracting Officer at least ten days prior to meeting.

1.5 PRODUCT DATA

1.5.1 Joint Sealant Instructions

Submit manufacturer's printed instructions including detailed application procedures, minimum and maximum application temperatures, and curing procedures. Include materials safety data sheets (MSDS) for materials to be used at the job site in accordance with 29 CFR 1926.59.

1.5.2 Coating System Instructions

Submit manufacturer's printed instructions including detailed mixing and application procedures, number and types of coats required, minimum and maximum application temperatures, and curing procedures. Include materials safety data sheets (MSDS) for materials to be used at the job site in accordance with 29 CFR 1926.59.

1.6 DELIVERY AND STORAGE

Ship, store, and handle materials in accordance with SSPC PA 1, and as modified in this Section. Maintain temperature in storage spaces between 40 and 85 degrees F, and air temperature more than 5 degrees F above the dew-point at all times. Inspect materials for damage prior to use and return non-compliant materials to manufacturer. Remove materials with expired shelf life from government property immediately and notify the Contracting Officer.

If materials are approaching shelf life expiration and an extension is desired, samples may be sent to the manufacturer, along with complete records of storage conditions, with a request for shelf life extension. If the manufacturer finds the samples and storage data suitable for shelf life extension, the manufacturer may issue an extension, referencing the product evaluation and the review of storage records. Products may not be extended longer than allowed in the product specification.

1.7 COATING HAZARDS

Ensure that employees are trained in all aspects of the safety plan. Specified coatings may have potential health hazards if ingested or improperly handled. The coating manufacturer's written safety precautions shall be followed throughout mixing, application, and curing of the coatings. During all cleaning, cleanup, surface preparation, and paint application phases, ensure that employees are protected from toxic and hazardous chemical agents which exceed concentrations in 29 CFR 1910.1000. Comply with respiratory protection requirements in 29 CFR 1910.134. The CIH shall approve work procedures and personal protective equipment.

1.8 JOB SITE REFERENCES

Make available to the Contracting Officer at least one copy each of ASTM D 3276, ASTM D 3925, ASTM D 4285, ASTM D 7127, SSPC SP COM, SSPC SP 1, SSPC SP 7, SSPC SP 10, SSPC PA 1, SSPC PA 2, SSPC Guide 6, SSPC VIS 1,

SSPC QP 1, SSPC QS 1, and an SSPC Certified Contractor Evaluation Form at the job site.

PART 2 PRODUCTS

2.1 JOINT SEALANT

TT-S-00230, Type II, Class B

2.2 COATING SYSTEM

Alternate systems or products will not be considered. All primer, intermediate coat and topcoat materials shall be supplied by one supplier. The entire coating system is intended to be applied in the field. Alternatively, surface preparation may be accomplished in the shop, following all temperature, humidity, and testing requirements listed herein, followed by an application of a hold-primer. Remove all shop-applied primer prior to final field surface preparation and coating system application. Adjust all shop preparation to avoid conflicts with final surface preparation requirements.

The Military specification epoxy and polyurethane products specified in this Section do not require approval for listing on the QPL prior to contract award, as indicated in paragraph 3.2 of MIL-DTL-24441 and paragraph 3.1 of MIL-PRF-85285. Testing of products by an independent laboratory to the QUALIFICATION INSPECTION requirements of MIL-DTL-24441 and MIL-PRF-85285prior to contract award is required. See specific submittal requirements in paragraph QUALITY ASSURANCE.

2.2.1 Zinc-Rich Epoxy Primer Coat

Epoxy polyamide, MIL-DTL-24441/19 (Formula 159, Type III).

2.2.2 Epoxy Intermediate Coat

Epoxy polyamide, MIL-DTL-24441/31 (Formula 152, Type IV, White (Tinted)). Tint to approximately FED-STD-595 color number 27778 parchment using pigment dispersions prepared for epoxy paint tinting. Manufacturer shall tint material and appropriately label. All other requirements of this Military Specification apply.

2.2.3 Polyurethane Topcoat

Polyurethane coating topcoat of MIL-PRF-85285, Type II, White FED-STD-595 color number 17925, Beige FED-STD-595 color number 27769 in gloss, White FED-STD-595 color number 17875, and Orange FED-STD-595 color number 12197.

Modify paragraph 3.6.4 of MIL-PRF-85285, Viscosity and Pot Life, as follows:

The viscosity of the admixed coating, when tested in accordance with ASTM D 1200 through a No. 4 Ford cup, shall be as follows:

Time from mix (minimum)	Maximum time through a No. 4 Ford cup
Initially	30 seconds
2 hours	60 seconds
4 hours	No gel

Modify paragraph 3.7.1 of MIL-PRF-85285, Drying Time, as follows:

When applied by spray techniques and when tested in accordance with ASTM D 1640, the coating shall be set-to-touch within four hours and dry-hard within eight hours (see 4.6 and table I).

2.3 COLOR IDENTIFICATION OF FUEL HANDLING AND STORAGE FACILITIES

Piping, conduit, and tank identification shall be in accordance with MIL-STD-161. Mark direction of fluids in accordance with MIL-STD-161. The NATO symbol for JP-8 is F-34.

2.4 COATING SAMPLE COLLECTION AND SHIPPING KIT

Provide a kit that contains one quart can for the base of each coating material, an appropriately sized can for each activator, dipping cups for each component to be sampled, a shipping box sized for the samples to to be shipped, and packing material. Mark cans for the appropriate component. Provide shipping documents, including either pre-paid shipping or a shipper number that can be used by the QC Manager to arrange pickup, addressed to the approved coating testing laboratory.

2.5 ABRASIVE SAMPLE COLLECTION AND SHIPPING KIT

Provide a kit that contains one suitable plastic bag or container for each sample to be collected. Mark containers for the appropriate component. Provide shipping documents, including either pre-paid shipping or a shipper number that can be used by the QC Manager to arrange pickup, addressed to the approved coating testing laboratory.

2.6 TEST KITS

2.6.1 Test Kit for Measuring Chloride, Sulfate and Nitrate Ions on Steel and Coated Surfaces

Provide test kits called CHLOR*TEST CSN Salts, as manufactured by CHLOR*RID International Inc. of Chandler, Arizona (www.chlor-rid.com) or equal. An "equal" test kit shall meet the following requirements:

a. Kit contains all materials,supplies, tools and instructions for field testing and on-site quantitative evaluation of chloride, sulfate and nitrate ions;

b. Kit extract solution is acidic, factory pre-measured, pre-packaged, and of uniform concentration;

c. Kit components and solutions are mercury free and environmentally friendly;

d. Kit contains new materials and solutions for each test extraction;

e. Extraction test container (vessel, sleeve, cell. etc.) creates a sealed, encapsulated environment during salt ion extraction;

f. Test extract container is suitable for testing the following steel surfaces: horizontal (up/down configuration), vertical, flat, curved, smooth, pitted, and rough;

g. All salt ion concentrations are directly measured in micrograms per square centimeter.

2.6.2 Test Kit for Identifying Amine Blush on Epoxy Surfaces

After coating and/or primer has hardened and prior to applying the next coat, test for unreacted amines using the AMINE BLUSH CHECK, manufactured by Elcometer, Rochester Hills, Michigan, or equal. To be considered for approval as an "equal" test kit it shall meet the following requirements:

a. Be a completely self-contained field test kit with all materials, supplies, tools and instructions to perform tests and indicate the presence of unreacted amines;

b. Use an identifiable, consistent, uniform, pre-packaged, factory pre-measured indicating solution;

c. Kit contains no mercury or lead and is environmentally friendly;

d. Kit contains a solution of an unreacted amine for the purpose of "self checking" the indicator solution;

2.7 ABRASIVE

The referenced abrasive specifications have maximum limits for soluble salts contamination, however, this maximum level of contamination does not guarantee that contamination will not be transferred to the steel surface during abrasive blasting. Other factors such as on-site handling and recycling can allow contamination of abrasive. Contractors are cautioned to verify that the chosen abrasive, along with work and storage processes, allow the final surface cleanliness requirements to be achieved. Successful testing of chlorides in abrasive does not negate the final acceptance testing of steel surfaces.

Interpret MIL-A-22262 to include the meaning that abrasive material contains a maximum one percent by weight of any toxic substance listed in either Table Z-1, Z-2, or Z-3 or 29 CFR 1910-SUBPART Z, with the exception of inert or nuisance dust materials, arsenic, beryllium, cadmium, cobalt, lead, mercury, rhodium, silver, tellurium, thallium, and uranium.

2.7.1 Non-metallic Abrasive

Conform to MIL-A-22262, Type I (Inorganic materials) except that the gross gamma radioactivity shall not exceed 5 picocuries per gram. Abrasive shall be approved by the Naval Sea Systems Command and listed on the appropriate Qualified Products List (QPL) for the specified materials. Use sampling procedures and testing frequencies as prescribed in MIL-A-22262. Use abrasive that is specifically selected and graded to provide a sharp, angular profile to the specified depth. Do not use ungraded abrasive. Make adjustments to processes or abrasive gradation to achieve specified surface profile. Recycled non-metallic abrasive shall meet all requirements of the specification each time that it is placed in the blast pot.

2.7.2 Metallic Abrasive

2.7.2.1 New and Remanufactured Steel Grit

Conform to the chemical and physical properties of SSPC AB 3 Class 1 (Steel) only, except that the gross gamma radioactivity shall not exceed 5 picocuries per gram. Class 2 (Iron) abrasive shall not be used.

To develop a suitable work mix from new steel abrasive, a minimum of 200 - 400 recycles is required, therefore, it is advantageous for a Contractor to use remanufactured steel grit or grit reclaimed from a previous project. Such grit shall be considered to conform if it can be traced to new grit conforming to SSPC AB 3 Class 1 and it meets all cleanliness requirements of SSPC AB 3 Class 1 when brought to the current jobsite. Submit one representative sample of this work mix to the laboratory for testing, along with samples of new material. Acceptance and use of this work mix shall not be used to justify any deviation from surface preparation requirements.

2.7.2.2 Recycled Steel Grit

Conform to the chemical and physical properties of SSPC AB 2

2.8 White Aluminum Oxide Non-skid Grit

Size #60, dust free (washed and dry), minimum 99 percent pure, having the following sieve analysis when tested in accordance with ASTM E 11 using a 2.2 pound sample:

Sieve #	% Retained
40	0
50	15-40
60	60-85

PART 3 EXECUTION

Perform all work, rework, and repair in accordance with approved procedures in the Coating Work Plan.

3.1 REMOVAL OF COATINGS CONTAINING HAZARDOUS MATERIALS

Coatings containing hazardous materials and identified for disturbance during surface preparation, including removal, shall be handled in accordance with Section 02 82 33.13 20 REMOVAL AND DISPOSAL OF LEAD CONTAINING PAINT. Coordinate surface preparation requirements from Section 02 82 33.13 20 REMOVAL AND DISPOSAL OF LEAD CONTAINING PAINT with this Section.

3.2 COATING AND ABRASIVE SAMPLE COLLECTION AND TESTING

Sample and test materials delivered to the jobsite. Notify Contracting Officer three days in advance of sampling. The QC Manager and either the PCS or coating inspector shall witness all sampling.

3.2.1 Coating Sample Collection

Provide a sample collection kit as required in paragraph COATING SAMPLE COLLECTION AND SHIPPING KIT. From each lot, obtain a one quart sample of each base material, and proportional samples of each activator based on mix ratio, by random selection from sealed containers in accordance with ASTM D 3925. Prior to sampling, mix contents of each sealed container to ensure uniformity. As an alternative to collecting small samples from kits, entire kits may be randomly selected and shipped to laboratory, observing all requirements for witnessing and traceability. For purposes of quality conformance inspection, a lot is defined as that quantity of materials from a single, uniform batch produced and offered for delivery at

one time. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Identify samples by designated name, specification number, batch number, project contract number, sample date, intended use, and quantity involved. The QC manager will take possession of the packaged samples, contact the shipping company to arrange for pickup, and relinquish the samples only to the shipping representative for shipment to the approved laboratory for testing as required by the paragraph COATING SAMPLE TEST REPORTS.

3.2.2 Abrasive Sample Collection

Provide a sample collection kit as required in paragraph ABRASIVE SAMPLE COLLECTION AND SHIPPING KIT. For purposes of quality conformance inspection, a lot shall consist of all abrasive materials of the same type from a single, uniform batch produced and offered for delivery at one time. Obtain samples of each abrasive lot using the sampling techniques and schedule of MIL-A-22262. The addition of any substance to a batch shall constitute a new lot. Identify samples by designated name, specification number, lot number, project contract number, sample date, intended use, and quantity involved. The QC manager will take possession of the packaged samples, contact the shipping company to arrange for pickup, and relinquish the samples only to the shipping representative for shipment to the approved laboratory for testing as required by the paragraph ABRASIVE SAMPLE TEST REPORTS.

3.2.3 Coating Sample Test Reports

Submit test results for each lot of coating material delivered to the jobsite. Test samples of primer, intermediate, and topcoat materials for compliance with requirements of Table I. Reject entire lot represented by samples that fail one or more tests, select new lots, and test samples.

3.2.4 Abrasive Sample Test Reports

Submit test results for each lot of abrasive delivered to the jobsite. Test samples of metallic abrasive to the requirements of paragraph REQUIREMENTS of SSPC AB 3, except paragraph 4.1.5 DURABILITY. Test samples of non-metallic abrasive as required in paragraph QUALITY CONFORMANCE INSPECTION of MIL-A-22262. Reject entire lot represented by samples that fail one or more tests, select new lots, and test samples.

3.3 SURFACES TO BE COATED

Coat exterior surfaces of tank, structure, including steel roof, shell, legs, stair, railing, and other exterior appurtenances.

3.4 LIGHTING

Provide lighting for all work areas as prescribed in SSPC Guide 12.

3.5 ENVIRONMENTAL CONDITIONS

3.5.1 Containment

Design and provide a containment system for the capture, containment, collection, storage and disposal of the waste materials generated by the work under this Section, to meet the requirements of SSPC Guide 6, Class 1, 2, 3. Vapor concentrations shall be kept at or below 10 percent of Lower Explosive Limit (LEL) at all times. Containment may be designed as

fixed containment for complete structure or portable containment for sections of structure, however, containment shall remain in any one place from beginning of abrasive blasting through initial cure of coating. Waste materials covered by this paragraph shall not include any material or residue from removal of coatings containing lead, chromium, cadmium, PCB, or any other hazardous material.

It is the Contractors responsibility to insure the feasibility and workability of the containment system. The Contractor shall perform his operations and work schedule in a manner as to minimize leakage of the containment system. The containment system shall be properly maintained and shall not deviate from the approved drawings. If the containment system fails to function satisfactorily, the Contractor shall suspend all operations, except those required to minimize adverse impact on the environment or government property. Operations shall not resume until modifications have been made to correct the cause of the failure.

3.5.2 Automated Monitoring Requirements

Provide continuous monitoring of temperature, relative humidity, and dew point data at pertinent points on the structure, during surface preparation, coating application, and initial cure. Locate sensors to provide pertinent data for the surface preparation and coat application being performed. Monitor any heating, cooling, or dehumidification equipment used. Make data available to the Contracting Officer through Internet access. Provide monitoring equipment to perform as follows:

a. Data is collected in the field unit in one minute increments, and available for download (on-site) in a standard format. Contractor shall collect this data and make available to the Contracting Officer;

b. Monitoring equipment shall have backup power such that data collection and transmission to web server will be uninterrupted during the entire period of the dehumidification requirement;

c. Monitoring equipment shall have capability to measure surface temperatures at a minimum of four locations anywhere on a 150 foot diameter by 50 foot high tank;

d. Monitoring equipment shall have capability to measure interior and exterior dry bulb temperature (DB), relative humidity (RH), and dewpoint temperature (DP);

e. Data shall be available continuously through secure Internet connection, using widely available web browsers;

f. Internet accessible data shall be collected and stored in maximum 15 minute increments, and lag time between data collection and online availability shall be no greater than 70 minutes;

g. Internet accessible data shall be available for viewing online in tabular format, and graphical format using selected data;

h. Internet accessible data shall be available for download in user-defined segments, or entire project to date, in a standard format usable by Microsoft Excel and other spreadsheet programs.

i. Internet-based controls shall provide alerts to pre-designated parties through email messaging;

j. Internet-based controls shall monitor data uploads from field unit and issue alert if data not initiated within 60 minutes of last upload;

k. Internet-based controls shall monitor operation of DH equipment and issues alert when power remains off for more than 15 seconds, or if pre-determined temperature, RH, or DP conditions are exceeded;

The requirements listed here were developed around the Munters Exactaire Monitoring System, as this was the only monitoring system having Internet connectivity known to be commercially available. There is no requirement for connectivity of the monitoring system to control the DH equipment, therefore, any combination of equipment having the required functionality will be accepted.

3.6 SURFACE PREPARATION

3.6.1 Abrasive Blasting Equipment

Use abrasive blasting equipment of conventional air, force-feed, or pressure type. Maintain a minimum pressure of 95 psig at nozzle. Confirm that air supply for abrasive blasting is free of oil and moisture when tested in accordance with ASTM D 4285. Test air quality at each startup, but in no case less often than every five operating hours.

3.6.2 Operational Evaluation of Abrasive

Test abrasive for salt contamination and oil contamination as required by the appropriate abrasive specification daily at startup and every five operating hours thereafter.

3.6.3 Surface Standard

Inspect surfaces to be coated, and select plate with similar properties and surface characteristics for use as a surface standard. Blast clean one or more 1 foot square steel panels as specified in paragraph SURFACE PREPARATION. Record blast nozzle type and size, air pressure at nozzle and compressor, distance of nozzle from panel, and angle of blast to establish procedures for blast cleaning. Measure surface profile in accordance with ASTM D 7127. When the surface standard complies with all specified requirements, seal with a clearcoat protectant. Use the surface standard for comparison to abrasive blasted surfaces throughout the course of work.

3.6.4 Pre-Preparation Testing for Surface Contamination

Perform testing, abrasive blasting, and testing in the prescribed order.

3.6.4.1 Pre-Preparation Testing for Oil and Grease Contamination

Inspect all surfaces for oil and/or grease contamination using two or more of the following inspection techniques: 1) Visual inspection, 2) WATER BREAK TEST, 3) CLOTH RUB TEST. Reject oil and/or grease contaminated surfaces, clean using a water based pH neutral degreaser in accordance with SSPC SP 1, and recheck for contamination until surfaces are free of oil and grease.

WATER BREAK TEST - Spray atomized mist of distilled water onto surface, and observe for water beading. If water "wets" surface rather than beading up, surface can be considered free of oil or grease contamination. Beading of

water (water forms droplets) is evidence of oil or grease contamination.

CLOTH RUB TEST - Rub a clean, white, lint free, cotton cloth onto surface and observe for discoloration. To confirm oil or grease contamination in lightly stained areas, a non-staining solvent may be used to aid in oil or grease extraction. Any visible discoloration is evidence of oil or grease contamination.

3.6.4.2 Pre-Preparation Testing for Soluble Salts Contamination

Test surfaces for soluble salts, and wash as required, prior to abrasive blasting. Soluble salt testing is also required in paragraph PRE-APPLICATION TESTING FOR SOLUBLE SALTS CONTAMINATION as a final acceptance test of prepared surfaces after abrasive blasting, and successful completion of this phase does not negate that requirement. This phase is recommended since pre-preparation testing and washing are generally more advantageous than attempting to remove soluble salt contamination after abrasive blasting. Effective removal of soluble salts will require removal of any barrier to the steel surface, including rust. This procedure may necessitate combinations of wet abrasive blasting, high pressure water rinsing, and cleaning using a solution of water washing and soluble salts remover. The soluble salts remover shall be acidic, biodegradable, nontoxic, noncorrosive, and after application, will not interfere with primer adhesion. Delays between testing and preparation, or testing and coating application, may allow for the formation of new contamination. Use potable water, or potable water modified with soluble salt remover, for all washing or wet abrasive blasting. Test methods and equipment used in this phase are selected at the Contractor's discretion.

3.6.5 Abrasive Blasting

Abrasive blast steel surfaces to near-white metal in accordance with SSPC SP 10. Prepared surfaces shall conform to SSPC VIS 1 and shall match the prepared test-panels. Provide a 2 to 3 mil surface profile. Reject profile greater than 3 mils, discontinue abrasive blasting, and modify processes and materials to provide the specified profile. Measure surface profile in accordance with ASTM D 7127, using Rmax as the measure of profile height. Record all measurements required in this standard. Measure profile at rate of three test areas for the first 1000 square feet plus one test area for each additional 1000 square feet or part thereof. When surfaces are reblasted for any reason, retest profile as specified. Following abrasive blasting, remove dust and debris by vacuum cleaning. Do not attempt to wipe surface clean.

3.6.6 Disposal of Used Abrasive

Dispose of used abrasive off Government property in accordance with Federal, State, and Local mandated regulations.

3.6.7 Pre-Application Testing For Surface Contamination

3.6.7.1 Pre-Application Testing for Oil and Grease Contamination

Ensure surfaces are free of contamination as described in paragraph PRE-PREPARATION TESTING FOR OIL AND GREASE CONTAMINATION, except that only questionable areas need be checked for beading of water misted onto surface.

3.6.7.2 Pre-Application Testing for Soluble Salts Contamination

Test surfaces for chloride contamination using the Test Kit described in TEST KIT FOR MEASURING CHLORIDE, SULFATE AND NITRATE IONS ON STEEL AND COATED SURFACES. Test all surfaces at rate of three tests for the first 1000 square feet plus one test for each additional 2000 square feet or part thereof. Concentrate testing of bare steel at areas of coating failure to bare steel and areas of corrosion pitting. Perform 30% of tests on bare steel at welds, divided equally between horizontal and vertical welds. One or more readings greater than 3 micrograms per square centimeter of chlorides or 10 micrograms per square centimeter of sulfates or 5 micrograms per square centimeter of nitrates is evidence of soluble salt contamination. Reject contaminated surfaces, wash as discussed in paragraph PRE-PREPARATION TESTING FOR SOLUBLE SALTS CONTAMINATION, allow to dry, and re-test until all required tests show allowable results. Reblast tested and cleaned areas as required. Label all test tubes and retain for test verification.

3.6.7.3 Pre-Application Testing for Surface Cleanliness

Apply coatings to dust free surfaces. To test surfaces, apply strip of clear adhesive tape to surface and rub onto surface with finger. When removed, the tape should show little or no dust, blast abrasive, or other contaminant. Reject contaminated surfaces and retest. Test surfaces at rate of three tests for the first 1000 square feet plus one test for each additional 1000 square feet or part thereof. Provide two additional tests for each failed test or questionable test. Attach test tapes to Daily Inspection Reports.

3.7 MIXING AND APPLICATION OF SEALANT AND COATING SYSTEM

3.7.1 Preparation of Sealant and Coating Materials for Application

Each of the sealant, primer, intermediate, and topcoat materials is a two-component material supplied in separate containers.

3.7.1.1 Mixing Sealant, Primer and Intermediate Coat Materials

Mix in accordance with manufacturer's instructions, which may differ for each product. Do not mix partial kits, or alter mix ratios. Mix materials in same temperature and humidity conditions specified in paragraph DELIVERY AND STORAGE. Allow mixed material to stand for the required induction time based on its temperature.

3.7.1.2 Mixing Topcoat Material

Do not mix partial kits, or alter mix ratios. Mix polyurethane coating materials in same temperature conditions specified in paragraph DELIVERY AND STORAGE. The polyurethane coating material is moisture sensitive and any introduction of moisture or water into the material during mixing or application will shorten usable pot life. Use a mixer that does not create a vortex. Do not add solvent without specific written recommendation from the manufacturer. No induction time is required, only thorough agitation of the mixed material.

3.7.1.3 Pot Life

Apply mixed products within stated pot life for each product. Stop applying when material becomes difficult to apply in a smooth, uniform wet

film. Add all required solvent at time of mixing. Do not add solvent to extend pot life. Pot life is based on standard conditions at 70 degrees F and 50 percent relative humidity. For every 18 degrees F rise in temperature, pot life is reduced by approximately half, and for every 18 degrees F drop it is approximately doubled. Usable pot life depends on the temperature of the material at the time of mixing and the sustained temperature at the time of application. Other factors such as the shape of the container and volume of mixed material may also affect pot life. Precooling or exterior icing of components for at least 24 hours to a minimum of 50 degrees F in hot climates will extend pot life. High humidity at time of mixing and application shortens pot life of the Polyurethane topcoat material. Following are approximate pot life times:

Epoxy primer and intermediate materials	4 hoursy manufacturer
Polyurethane topcoat materials	2 hours.

3.7.1.4 Application Conditions and Recoat Windows

The application condition requirements for the coating system are very time and temperature sensitive, and are intended to avoid the delamination problems frequently found on industrial structures. Plan coating application to ensure that specified temperature, humidity, and condensation conditions are met. If conditions do not allow for orderly application of sealant, primer, stripe coat, intermediate coat and topcoat, use appropriate means of controlling air and surface temperatures, as required. Partial or total enclosures, insulation, heating or cooling, or other appropriate measures may be required to control conditions to allow for orderly application of all required coats.

Maintain air and steel surface temperature between 60 and 100 degrees F during application and the first four hours of cure for epoxy coats and the first eight hours of cure for polyurethane coats. Maintain steel surface temperature more than 5 degrees F above the dew-point of the ambient air for the same period.

Use Table entitled "RECOAT WINDOWS" to determine appropriate recoat windows for each coat after the initial coat. Apply each coat during appropriate RECOAT WINDOW of preceding coat. If a RECOAT WINDOW is missed, the minimum and maximum primer and intermediate coat thickness may be adjusted to accommodate a FILL COAT, however, requirements for total epoxy coating thickness and total coating thickness will not be modified. Missing more than one RECOAT WINDOW may require complete removal of coating if maximum total coating thickness requirements cannot be achieved.

If coating is not applied during RECOAT WINDOW, or if surface temperature exceeds 120 degrees F between applications, provide GLOSS REMOVAL, apply next coat within 24 hours. If next planned coat is topcoat, apply FILL COAT if required to fill sanding marks. Sanding marks from GLOSS REMOVAL of intermediate coat reflecting through topcoat will be considered as noncompliant. Apply FILL COAT within 24 hours of GLOSS REMOVAL, then apply topcoat within RECOAT WINDOW of FILL COAT.

RECOAT WINDOWS

EPOXY OVER EPOXY

Temperature degrees F	60-70	71-80	81-90	91-100	101-110	111-120
RECOAT WINDOW (Hrs.)	24-72	18-60	16-48	12-36	8-18	4-6

RECOAT WINDOWS

POLYURETHANE OVER EPOXY

Temperature degrees F	60-70	71-80	81-90	91-100	101-110	111-120
RECOAT WINDOW (Hrs.)	24-96	24-72	16-48	12-36	10-24	8-16

POLYURETHANE OVER POLYURETHANE

Temperature degrees F	60-70	71-80	81-90	91-100	101-110	111-120
RECOAT WINDOW (Hrs.)	8-48	6-48	4-36	3-24	2-12	1-2

The temperature ranges shown in the table above are for determining recoat windows. Choose recoat window based on the highest surface temperature that was sustained for one or more hours between coats. This applies to the entire time between coats. Measure and record air and surface temperatures on hourly basis to determine appropriate recoat windows. If surface temperature goes above 100 degrees F, measure and record temperatures every half hour.

FILL COAT - Where indicated, apply coat of intermediate coat epoxy, at 2 to 3 mils DFT, then apply next specified full coat within recoat window of FILL COAT. A FILL COAT may be used to adjust coating thickness to comply with requirements or to fill sanding marks in intermediate coat.

GLOSS REMOVAL - Where required, hand sand in a linear fashion to remove gloss using 120-200 grit wet/dry sandpaper, followed by solvent wiping with a clean rag soaked with denatured alcohol to remove all dust. GLOSS REMOVAL of primer coat is to scarify surface and shall consist of removal of approximately 1 mil of coating. If steel is exposed during GLOSS REMOVAL, repair in accordance with paragraph PROCEDURE FOR HOLIDAY AND SPOT REPAIRS OF NEWLY APPLIED COATING. GLOSS REMOVAL of intermediate coat may include removal of up to 3 mils of coating to avoid excess thickness, prior to application of FILL COAT.

3.7.2 Amine Blush Testing of Epoxy Coat Prior to Overcoating

Test epoxy surfaces prior to application of roof joint sealant, epoxy coat, or polyurethane topcoat for amine blush contamination using the Test Kit described in paragraph TEST KIT FOR IDENTIFYING AMINE BLUSH ON EPOXY SURFACES. Test all surfaces at rate of three tests for the first 1000 square feet plus one test for each additional 2000 square feet or part thereof. Remove any identified contamination using an approved procedure.

3.7.3 Application of Coating System and Joint Sealant

Apply coatings in accordance with SSPC PA 1 and as specified herein. Apply coatings to surfaces that meet all stated surface preparation requirements.

After application of primer coat and prior to application of each subsequent coat, perform testing prescribed in paragraph PRE-APPLICATION TESTING FOR SURFACE CONTAMINATION, as necessary, to ensure minimal intercoat contamination. This testing may be reduced to one half of the prescribed rate for bare steel if the testing indicates no contamination when sampling is evenly distributed over surfaces being tested. If contamination is found between coats, revert to the specified testing

rate. Generally, oil and grease contamination and soluble salts contamination are not encountered if subsequent coats are applied within specified recoat windows and unusual atmospheric events do not occur. Such atmospheric events as a coastal storm blowing onshore can bring unusual chloride contamination. Concern for intercoat contamination should be continually prevalent, and spot testing should be accomplished to verify satisfactory conditions. Where visual examination or spot testing indicates contamination, perform sufficient testing to verify non-contamination, or to define extent of contamination for appropriate treatment.

Apply each coat in a consistent wet film, at 90 degrees to previous coat. Ensure that primer and intermediate coat "cold joints" are no less than six inches from welds. Apply stripe coat by brush. For convenience, stripe coat material may be delivered by spray if followed immediately with brush-out and approved procedures include appropriate controls on thickness. Apply all other coats by spray application. Use appropriate controls to prevent airborne coating fog from drifting beyond 15 feet from the structure perimeter, the tank berm. Cover or protect all surfaces that will not be coated. The cleanliness, temperature, recoat windows, and airborne paint containment requirements may necessitate the use of enclosures, portable shelters, or other appropriate controls.

Apply coatings at the following specified thickness:

Coat	Minimum DFT (Mils)	Maximum DFT (Mils)
Primer	3	5
Intermediate	3	5
Top	2	3
Total system	8	13

3.7.3.1 Application of Primer

Apply primer coat, maintaining paint supply container height within 3 feet of the paint nozzle for applying zinc primer. Maintain constant agitation of paint pot to ensure that zinc does not settle in container.

3.7.3.2 Application of Stripe Coat

Apply a stripe coat of intermediate coat epoxy material within RECOAT WINDOW of primer, allowing sufficient dry time to allow application of intermediate coat within RECOAT WINDOW of primer. Apply by brush, working material into corners, crevices, angles, and welds, and onto outside corners and angles.

3.7.3.3 Application of Intermediate Coat

Apply intermediate coat within RECOAT WINDOW of primer coat.

3.7.3.4 Non-skid for Stairs and Top

Where non-skid is required, apply a second intermediate coat, and immediately follow with application of non-skid grit, broadcast at the rate of 2 pounds per 100 square feet, and backroll. Apply topcoat as specified.

3.7.3.5 Application of Topcoat

Make all required repairs to primer and intermediate coats as specified in paragraph entitled "Procedure for Holiday and Spot Repairs of Newly Applied Coating" prior to applying topcoat. Apply topcoat within RECOAT WINDOW of intermediate coat. The polyurethane topcoat may require multiple passes to achieve desired aesthetics and required thickness. Consult manufacturer for thinning and application procedures for anticipated temperature, humidity, and wind conditions. Touch-up blemishes and defects within recoat window of polyurethane topcoat. Retain sample of polyurethane topcoat, from the same batch used to coat structure, to make touch-ups that might be required later.

3.7.3.6 Application of Joint Sealant

Apply joint sealant to back-to-back steel joints that are less that 3/8 inches wide and are not seal welded. Apply sealant to top and bottom, or each side, of narrow joints. Apply sealant within 48 hours of application of the topcoat, and touch-up with topcoat after appropriate cure of the sealant.

3.7.3.7 Procedure for Holiday and Spot Repairs of Newly Applied Coating

Repair coating film defects at the earliest practicable time, preferably before application of the succeeding coat. Observe all requirements for soluble salts contamination, cleanliness between coats, and application conditions. Prepare defective area in accordance with SSPC SP 10, and feather coating as required to leave 4 inches of each succeeding coat feathered and abraded. Protect adjacent areas from damage and overspray. Remove dust and solvent wipe the prepared area plus an additional 4 inches beyond the prepared area with clean denatured alcohol. Apply each coat within RECOAT WINDOW of preceeding coat. Within four hours of preparation, apply zinc-rich primer to prepared steel and feather onto prepared primer. Apply intermediate coat to primed area and feather to prepared intermediate area. Apply topcoat to intermediate coat and feather to prepared topcoat. Apply each repair coat to approximate thickness of surrounding coating system.

3.7.3.8 Structure Occupancy After Coating Application

Use clean canvas or other approved shoe covers when walking on coated surfaces, regardless of curing time allowed. For heavily trafficked areas, provide cushioned mats for additional protection.

3.8 PROJECT IDENTIFICATION

At the completion of the work, stencil the following information on the structure, tank exterior adjacent to the main manway opening in 3/4 to one inch Helvetica style letters of contrasting color using acrylic stencil paint:

Date exterior coated:
Project Number:
Contractor:
Address:
Coating System
Surface Prep: SSPC SP __ Profile: ____
Primer: _____ Thickness: ____
Intermediate: _____ Thickness: ____

Topcoat: _____ Thickness: ____
Total Thickness: ____

3.9 FIELD QUALITY CONTROL

For marking of tank surfaces, use chalk for marking bare steel, and water based markers for marking coated surfaces, and remove marks prior to coating. Do not use any wax or grease based markers, or any other markers that leave a residue or stain.

3.9.1 Coating Inspector

The coating inspector shall be considered a QC Specialist and shall report to the QC Manager, as specified in Section 01 45 02 NAVFAC QUALITY CONTROL. The Coating Inspector shall be present during all pre-preparation testing, surface preparation, coating application, initial cure of the coating system, during all coating repair work, and during completion activities as specified in Section 01 45 02 NAVFAC QUALITY CONTROL. The Coating Inspector shall provide complete documentation of conditions and occurrences on the job site, and be aware of conditions and occurrences that are potentially detrimental to the coating system. The requirements for inspection listed in this Section are in addition to the QC inspection and reporting requirements specified in Section 01 45 02 NAVFAC QUALITY CONTROL.

3.9.2 Field Inspection

3.9.2.1 Inspection Requirements

Perform field inspection in accordance with ASTM D 3276 and the approved Coating Work Plan. Document Contractor's compliance with the approved Coating Work Plan.

Provide all tools and instruments required to perform the required testing, as well as any tools or instruments that the inspector considers necessary to perform the required inspections and tests. Document each inspection and test, including required hold points and other required inspections and tests, as well as those inspections and tests deemed prudent from on-site evaluation to document a particular process or condition, as follows:

a. Location or area;
b. Purpose (required or special);
c. Method;
d. Criteria for evaluation;
e. Results;
f. Determination of compliance;
g. List of required rework;
h. Observations.

Collect and record Environmental Conditions as described in ASTM D 3276 on a 24 hour basis, as follows:

a. During surface preparation, every two hours or when changes occur;
b. During coating application and the first four days of initial cure, every hour, or when changes occur;
c. Note location, time, and temperature of the highest and lowest surface temperatures each day;
d. Use a non-contact thermometer to locate temperature extremes, then verify with contact thermometers.

Document all equipment used in inspections and testing, including manufacturer, model number, serial number, last calibration date and future calibration date, and results of on-site calibration performed.

Document Contractors compliance with the approved Coating Work Plan.

3.9.2.2 Inspection Report Forms

Develop project-specific report forms as required to report measurements, test results, and observations being complete and and conforming to contract requirements. This includes all direct requirements of the contract documents and indirect requirements of referenced documents. Show acceptance criteria with each requirement and indication of conformity of each inspected item. The data may be in any format, but must be legible and presented so that entered data can be quickly compared to the appropriate requirement.

3.9.2.3 Daily Inspection Reports

Submit one copy of daily inspection report completed each day when performing work under this Section, to the Contracting Officer. Note all non-compliance issues, and all issues that were reported for rework in accordance with QC procedures of Section 01 45 02 NAVFAC QUALITY CONTROL. Each report shall be signed by the coating inspector and the QC Manager. Submit report within 24 hours of date recorded on the report.

3.9.2.4 Inspection Logbook

A continuous record of all activity related to this Section shall be maintained in an Inspection Logbook on a daily basis. The logbook shall be hard or spiral bound with consecutively numbered pages, and shall be used to record all information provided in the Daily Inspection Reports, as well as other pertinent observations and information. The Coating Inspector's Logbook that is sold by NACE is satisfactory. Submit the original Inspection Logbook to the Contracting Officer upon completion of the project and prior to final payment.

3.9.2.5 Inspection Equipment

All equipment shall be in good condition, operational within its design range, and calibrated as required by the specified standard for use of each device.

3.10 FINAL CLEANUP

Following completion of the work, remove debris, equipment, and materials from the site. Remove temporary connections to Government or Contractor furnished water and electrical services. Restore existing facilities in and around the work areas to their original condition.

TABLE 1
COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ia - Zinc-rich Epoxy Primer Coat MIL-DTL-24441/19 Formula 159

Test	Component A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Pigment content, percent (zinc dust)	---	---	81.5	85.5	---	---
Volatiles, percent	42.8	44.3	8.0	8.4	---	---
Non-volatile vehicle percent	53.7	57.7	8.3	8.7	---	---
Weight,						
Kilograms/liter	0.87	1.01	3.30	3.40	2.80	2.91
Pounds/gallon	7.3	8.4	27.5	28.4	23.4	24.4
Flashpoint						
Degrees C	35.6	---	37.8	---	---	---
Degrees F	96	---	100	---	---	---
Consistency, grams	---	---	250	500	150	300
Set to touch time, hours at 23 degrees C, 73 degrees F	---	---	---	---	---	2
Dry-hard time, hours at 23 degrees C, 73 degrees F	---	---	---	---	---	8
Pot life, hours at 23 degrees C, 73 degrees F	---	---	---	---	4	---
Sag resistance						
Micrometers	---	---	---	---	300	---
Mils	---	---	---	---	12	---
VOC						
Grams/liter	---	---	---	---	---	304
Pounds/gallon	---	---	---	---	---	2.5

NOTES:
Test methods as specified in MIL-DTL-24441.

TABLE 1
COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ib. - Epoxy Intermediate Coat MIL-DTL-24441/31 Formula 152 Type IV (White (Tinted))

Test	Component A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Pigment content, percent	44.0	49.0	33.0	38.0	---	---
Volatiles, percent	29.0	35.0	16.0	21.0	---	---
Non-volatile vehicle, percent	17.5	23.5	44.0	49.0	---	---
Coarse particles, percent	---	0.3	---	0.3	---	---
Consistency, grams	180	320	300	470	180	245
Weight						
Kilograms/liter	1.39	1.45	1.29	1.35	1.34	1.40
Pounds per gallon	11.6	12.1	10.8	11.3	11.2	11.7
Set to touch, hours at 23 degrees C, 73 degrees F	---	---	---	---	---	3
Dry-hard time, hours at 23 degrees C, 73 degrees F	---	---	---	---	---	8
Fineness of grind, Hegman	4	---	4	---	---	---
Flashpoint						
Degrees C	35.5	---	37.8	---	---	---
Degrees F	96	---	100	---	---	---
Titanium dioxide, percent of pigment	91	---	---	---	---	---
Pot life, hours at 23 degrees C, 73 degrees F	---	---	---	---	4	---
Sag resistance						
Micrometers	---	---	---	---	300	---
Mils	---	---	---	---	12	---
Color of dry film to approximate color of FED-STD 595 color 27778	---	---	---	---	Conform	
Contrast ratio, at 75 micrometers, 3 mils DFT	---	---	---	---	0.98	---
Gloss, 60 degree specular	---	---	---	---	35	---
VOC						
Grams/liter	---	---	---	---	---	340
Pounds/gallon	---	---	---	---	---	2.8

GENERAL NOTES:
Test methods as specified in MIL-DTL-24441.
Where "Conform" is indicated, refer to specific requirements of MIL-DTL-24441/31.

TABLE 1
COATING QUALITY CONFORMANCE INSPECTION REQUIREMENTS

Table Ic - Polyurethane Topcoat MIL-PRF-85285 Type II
(White and Colors)

Test	Component A		Component B		Mixed	
	Min.	Max.	Min.	Max.	Min.	Max.
Moisture content, percent	---	2	---	---	---	---
Coarse particles, percent	---	---	---	---	---	.5
Viscosity	---	---	---	---	See Note 1	
Fineness of grind, Hegman	---	---	---	---	7	---
Drying to touch (See Note 2)	---	---	---	---	---	4
Dry hard (See Note 2)	---	---	---	---	---	8
VOC, grams per liter	---	---	---	---	---	340
Color	---	---	---	---	delta E+-1.0	
Gloss 60 degree specular gloss						
Gloss	---	---	---	---	---	90
Semi-gloss	---	---	---	---	15	45
Opacity	---	---	---	---	0.95	---
Flexibility	---	---	---	---	Conform	
Fluid resistance	---	---	---	---	Conform	
Heat resistance (cure)	---	---	---	---	Conform	
Solvent resistance (cure)	---	---	---	---	Conform	
Condition in container	---	---	---	---	Conform	
Odor	---	---	---	---	Conform	
Lead percent	---	---	---	---	---	0.06
Cadmium percent	---	---	---	---	---	0.06
Chromium percent	---	---	---	---	---	0.00

NOTES:
(1) Modify paragraph 3.6.4 Viscosity and Pot Life, of MIL-PRF-85285 as follows:

The viscosity of the admixed coating, when tested in accordance with ASTM D 1200 through a No. 4 Ford cup, shall be as follows:

Time from mix (minimum)	Maximum time through a No. 4 Ford cup
Initially	30 seconds
2 hours	60 seconds
4 hours	No gel

(2) Modify paragraph 3.7.1 Drying Time, of MIL-PRF-85285

When applied by spray techniques and when tested in accordance with ASTM D 1640, the coating shall be set-to-touch within four hours and dry-hard within eight hours (see 4.6 and table I).

GENERAL NOTES:
- Test methods as specified in MIL-PRF-85285.
- Where "Conform" is indicated, refer to specific requirements of MIL-PRF-85285.

-- End of Section --

SECTION 10 14 01

EXTERIOR SIGNAGE

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2004) Safety Glazing Materials Used in Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1	(2000; R 2006)Resistance Welding
AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2003; Errata 2004) Structural Welding Code - Aluminum

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1011/A 1011M	(2007) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(2007) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 108	(2006) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 26/B 26M	(2005) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 62	(2002) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM C 1036	(2006) Standard Specification for Flat Glass
ASTM D 3841	(1997; R 2001) Standard Specification for Glass Fiber-Reinforced Polyester Plastic Panels
ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS3611	(1994; Rev D; R 2003) Plastic Sheet, Polycarbonate General Purpose

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

Drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Modular Exterior Signage System

Manufacturer's descriptive data and catalog cuts.

Installation

Manufacturer's installation instructions and cleaning instructions.

Exterior Signage

Exterior signage schedule in electronic media with spread sheet format. Spread sheet shall include sign location, sign type, and message.

Wind Load Requirements

Design analysis and supporting calculations performed in support of specified signage.

SD-04 Samples

Exterior Signage

One 12 inch length of framing for illuminated signs. One sample of each type of sign. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Three color samples for each material requiring color and 12 inch square sample of sign face color sample.

SD-10 Operation and Maintenance Data

Protection and Cleaning

Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed.

1.3 GENERAL

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Recyclable materials shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

1.4 WIND LOAD REQUIREMENTS

Exterior signage shall be designed to withstand 130 mph windload.

1.5 CHARACTER PROPORTIONS AND HEIGHTS

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from

which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.6 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.7 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.8 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.9 EXTRA STOCK

The Contractor shall provide one extra interchangeable message panels and extra stock of the following: one message bars of each color and size for sign types. three pressure-sensitive letters in each color and size for sign type. Three changeable message strips for sign type.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage shall consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown.

2.1.1 Free-Standing Base Mount Pylon/Monolith Type Signs

2.1.1.1 Framing

Interior framing shall consist of aluminum or galvanized steel tube columns welded to companion plates. Perimeter framing shall consist of aluminum or steel angle framing welded to the post and plate system as designed. Framing members shall be designed to permit access to electrical equipment and panel removal. Mounting shall be provided as shown. Framing members of steel shall be finished with semi-gloss baked enamel or two-component acrylic polyurethane. Openings shall be sealed from moisture and made tamper-proof.

2.1.1.2 Exterior Sheeting Panels

Modular panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.090 inch thick aluminum 0.125 inch thick fiberglass reinforced plastic (FRP). Top and end panels shall be removable and shall be secured by 3/16 inch socket head jack nuts. Finish for metal panels shall be semi-gloss baked enamel or anodized conforming to AA DAF-45.

2.1.1.3 Mounting

Mounting shall be provided by securing to concrete foundation as shown.

2.1.1.4 Finishes

Base finish shall be semi-gloss baked enamel or anodized conforming to AA DAF-45. Metal panel system finish shall be baked enamel anodized conforming to AA DAF-45, as shown.

2.1.2 Panel And Post/Panel Type Signs

2.1.2.1 Posts

One-piece aluminum or galvanized steel posts shall be provided with minimum 0.125 inch wall thickness. Posts shall be designed to accept panel framing system described. The post shall be designed to permit attachment of panel framing system without exposed fasteners. Caps shall be provided for each post.

2.1.2.2 Panel Framing System

Panel framing consisting of aluminum sections and interlocking track components shall be designed to interlock with posts with concealed fasteners.

2.1.2.3 Panels

Modular message panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.090 inch aluminum 0.125 inch acrylic or 0.125 inch fiberglass reinforced plastic (FRP). Panels shall be designed to be interchangeable. Panels with metal return sheeting shall have welded corners, ground smooth. Face panels shall be removable to provide access to electrical components.

2.1.2.4 Finishes

Post finish shall be semi-gloss baked enamel or anodized conforming to AA DAF-45. Metal panel system finish shall be baked enamel anodized conforming to AA DAF-45, as shown.

2.1.2.5 Mounting

Permanent mounting shall be provided by embedding posts in concrete foundation as shown. Removable mounting shall be provided by a steel or an aluminum flange embedded in concrete as shown.

2.1.3 Changeable Letter Directories

2.1.3.1 Frame and Trim

Aluminum alloy finish shall be as indicated on drawings.

2.1.3.2 Header Plates

Header plate shall consist of background metal matching frame and having raised letters attached through the back.

2.1.3.3 Door Glazing

Door glazing shall be clear safety or tempered glass minimum 1/4 inch thick.

2.1.3.4 Door Construction

Door frame shall be of same material and finish as surrounding frame. Corners shall be mitered, reinforced or welded, and assembled with concealed fasteners. Hinges shall be standard with manufacturer, in finish to match frames and trim. Glazing shall be set in frame with resilient glazing channels.

2.1.3.5 Door Locks

Door locks shall be manufacturer's standard and shall be keyed alike.

2.1.3.6 Fabrication

Frames and trim shall be assembled with corners reinforced or welded and mitered to hairline fit, with no exposed fasteners. Removable changeable directory panel shall consist of 1/4 inch thick white acrylic with clear acrylic letter tracks aluminum back with vinyl or polycarbonate covering backgrooved 1/4 inch on centers to receive letters.

2.1.3.7 Finishes

Post finish shall be semi-gloss baked enamel or anodized conforming to AA DAF-45. Metal panel system finish shall be baked enamel or two-component acrylic polyurethane, anodized conforming to AA DAF-45, as shown.

2.1.3.8 Mounting

Directories shall be mounted to supporting structures with concealed fasteners in accordance with manufacturer's instructions.

2.1.3.9 Changeable Letters

Changeable letters shall be upper-case or upper and lower-case helvetica medium. Tabbed vinyl letters and numbers shall be furnished in accordance with the drawings and schedule.

2.2 ILLUMINATION

Concealed lighting shall be provided within panel framing members. Lighting shall be controlled by a photocell device. Top, Back lighting shall be provided by T-12 slimline lamps, 120 volt, 60-hertz, single-phase, Type 1, or Type 2 ballast. Ballast shall be integrally mounted, high power factor and rated for use down to minus 20 degrees F ambient starting temperature. Ballast and wiring within the sign shall be in metal raceways. Electrical equipment shall be UL or FM listed and comply with NFPA 70. Illumination shall be evenly distributed. A switch on the interior of the sign shall be provided to turn off power in the sign. Switch shall be readily accessible when sign is open.

2.3 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.3.1 Graphics

Signage graphics shall conform to the following:

a. Cast or Custom fabricated aluminum letters, 1/2 inch thick shall be provided and fastened to the message panel with concealed fasteners. Letters shall project 2 inches from face of panel.

b. Pressure sensitive precision cut vinyl letters with reflecting surface shall be provided.

c. Message letters shall be cut out from panel. Panel cutouts shall be backed with 0.080 inch FRPor 0.125 inch acrylic where cutouts occur.

d. Message shall be cut out from panel. Acrylic letters 1/4 inch thick shall be projected through the cutout area and chemically welded to 0.125 inch thick acrylic backup sheet.

e. Message shall be embedded in FRP sheet and completely covered with thermosetting polyester resin. Message shall be embedded minimum 1/32 inch. Sheets shall be processed in one piece, in one process, to prevent delamination.

f. Message shall be applied using the frisket method. Photomechanically reproduced graphic masks shall be applied to the sign face which has been coated with the graphics color. A background shall then be applied to the exposed surfaces. Handcut masks will not be accepted. Edges that are nicked, cut, or ragged will not be acceptable. A protective overcoat containing UV-resistant additives shall be applied.

g. Message shall be engraved in non-corrosive, three-ply fiberglass laminate. Message shall be core color or paint filled multiple colors.

2.3.2 Messages

See drawings and schedule for message content. Typeface: Helvetica medium. Type size as indicated.

2.4 METAL PLAQUES

Design and location of plaques shall be as shown.

2.4.1 Cast Metal Plaques

2.4.1.1 Fabrication

Cast metal plaques shall have the logo, emblem and artwork cast in the bas relief technique. Plaques shall be fabricated from prime aluminum, bronze, or yellow brass as indicated.

2.4.1.2 Size

Plaque size shall be as shown.

2.4.1.3 Border

Border shall be custom ornamental as shown.

2.4.1.4 Background

Background texture shall be fine pebble.

2.4.1.5 Mounting

Mounting shall be concealed or invisible.

2.4.1.6 Finish

Finishes shall consist of aluminum light colored sandblasted background. Letters shall be satin polished and entire plaque shall be sprayed with two coats of clear lacquer, aluminum with background sprayed dark gunmetal colored lacquer. Letters shall be satin polished and entire plaque sprayed with two coats clear lacquer, bronze with dark finish oxidized background. Letters shall be satin polished and entire plaque sprayed with two coats of clear lacquer, aluminum, bronze with sprayed background. Letters shall be satin polished.

2.4.2 Chemically Etched Metal Plaques

2.4.2.1 Fabrication

Plaque shall be chemically etched one-piece brass or bronze 0.125 inch thick.

2.4.2.2 Size

Plaque size shall be as shown.

2.4.2.3 Finish

Single-etched raised areas shall be in bronze-tone finish and recessed areas shall be colorfilled. Double-etched raised areas shall be in bronze-tone and recessed textured areas shall be silver-tone colorfilled as indicated.

2.4.3 Frost and Surface Oxidized Plaques

2.4.3.1 Fabrication

Plaque shall be frosted and surface oxidized one - piece anodized aluminum, brass, or bronze 0.125 inch thick.

2.4.3.2 Size

Plaque size shall be as shown.

2.4.3.3 Finish

Material finish shall be satin or polished. Frosted areas shall be oxidized black for aluminum or stainless steel or black or brown, for brass or bronze.

2.5 DIMENSIONAL BUILDING LETTERS

2.5.1 Fabrication

Letters shall be fabricated from cast aluminum or cast bronze 0.125 inch aluminum sheet extruded aluminum. Letters shall be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters shall be packaged for protection until installation.

2.5.2 Typeface

Typeface shall be as indicated.

2.5.3 Size

Letter size shall be as indicated.

2.5.4 Finish

Anodized aluminum or Baked enamel Polished or Oxidized bronze with clear coat finish shall be provided.

2.5.5 Mounting

Threaded studs of number and size as recommended by manufacturer, shall be used for concealed anchorage. Letters which project from the building line shall have stud spacer sleeves. Letters, studs, and sleeves shall be of the same material. Templates for mounting shall be supplied.

2.6 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 209 for sheet or plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall conform to AWS C1.1M/C1.1.

2.7 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

Integrated color anodized designation AA-M10-C22-A32, Architectural Class 0.4 to 0.7 mil.

Electrolytically deposited color - anodized designation AA-M10-C22-A34, Architectural Class II 0.4 to 0.7 mil.

2.8 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a semi-gloss baked enamel finish in accordance with NAAMM AMP 500, AMP 505, with total dry film thickness not less than 1.2 mils.

2.9 STEEL PRODUCTS

Structural steel products shall conform to ASTM A 36/A 36M. Sheet and

strip steel products shall conform to ASTM A 1011/A 1011M. Welding for steel products shall conform to AWS D1.2/D1.2M.

2.10 CAST BRONZE

Components shall be fabricated with sharp corners, flat faces, and accurate profiles. Burrs and rough spots shall be removed and polished. Faces shall be finished to a uniform high luster. Cast bronze shall be in accordance with ASTM B 62.

2.11 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting shall be 5 to 7 year premium type and shall be in accordance with the flammability requirements of ASTM E 84 and shall be a minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.12 GLASS

Glass shall be in accordance with ASTM C 1036, Type I, Class 1, Quality q3 and ANSI Z97.1.

2.13 FIBER-REINFORCED POLYESTER (FRP) PANELS

Fiber-reinforced polyester (FRP) shall be in accordance with ASTM D 3841, Type II, Grade 1, Class 124, as indicated.

2.14 ACRYLIC SHEET

Acrylic sheet shall be in accordance with the flammability requirements of ASTM E 84 and shall conform to ANSI Z97.1.

2.15 POLYCARBONATE SHEET

Polycarbonate sheet shall conform to SAE AMS3611.

2.16 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish and shall be non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.

2.17 SHOP FABRICATION AND MANUFACTURE

2.17.1 Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A 123/A 123M and ASTM A 653/A 653M, as applicable. Other metallic coatings of steel sheet

shall be in accordance with ASTM A 924/A 924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.17.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.17.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.

2.18 COLOR, FINISH, AND CONTRAST

Color shall be as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. For buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings. Circuits installed underground shall conform to the requirements of Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Steel conduits installed underground and illuminated signage mounted directly on buildings shall be in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with

manufacturer's instructions. After signs are completed and inspected, the Contractor shall cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Signs shall be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames shall be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass shall be protected from paint. Finish shall be free of scratches or other blemishes.

-- End of Section --

SECTION 10 14 02

INTERIOR SIGNAGE

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes
AA PK-1	(2002) Pink Sheets: Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604	(2005) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2004) Safety Glazing Materials Used in Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2003; Errata 2004) Structural Welding Code - Aluminum

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM C 1036	(2006) Standard Specification for Flat Glass
ASTM D 635	(2006) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Installation

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Samples

Interior Signage

One sample of each of the following sign types showing typical quality, workmanship and color. The samples may be installed in the work, provided each sample is identified and location recorded.

a. Directional sign.

b. Standard Room sign.

c. Changeable message strip sign.

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions
Protection and Cleaning

Six copies of operating instructions outlining the step-by-step procedures required for system operation shall be provided. The instructions shall include simplified diagrams for the system as installed. Six copies of maintenance instructions listing routine procedures, repairs, and guides shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number.

1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings/attachments/signage placement schedule (as applicable), shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Signage shall be obtained from a single manufacturer with edges and corners of finished letterforms and graphics true and clean. Recyclable materials shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 EXTRA STOCK

The Contractor shall provide extra frames and extra stock of the following: Three blank plates of each color and size for sign types.

PART 2 PRODUCTS

2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

2.1.1 Standard Room Signs

Signs shall consist of acrylic plastic 0.080 inch thickness minimum conforming to ANSI Z97.1 laminated thermosetting Type MP plastic (three-ply melamine plastic laminate with phenolic core) 6063-T5 extruded aluminum in accordance with ASTM B 221 and ASTM B 209 and shall conform to the following:

Frames shall be aluminum or molded acrylic. Frames shall be 1/4 inch wide.

End caps shall be aluminum or molded acrylic with square style corners.

Units shall be frameless. Corners of signs shall be rounded to 1/2 inch radius.

2.1.2 Type of Mounting For Signs

Extruded aluminum brackets shall be furnished for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be mounted with countersunk mounting holes in plaques and mounting screws fabricated from materials that are not corrosive to sign material and mounting surface.

2.1.3 Graphics

Signage graphics for modular signs shall conform to the following:

Engraved Copy: Machine engrave letters, numbers, symbols, and other graphics into panel sign on face to produce precisely formed copy and sharp images, incised to uniform depth. Melamine plastic engraving stock used for ADA compliant graphic shall be three-ply lamination contrasting color core meeting ASTM D 635

Graphic Blast Raised Copy: Background is sandblasted to a uniform depth of 1/32 inch leaving raised text and Braille. Background shall be painted with polyurethane paint.

Embossed: Methods other than sandblasting such as vacuum formed to create ADA compliant projected graphics.

Cast, Fabricated, or Solid Aluminum Letters: 1/4 inch thick shall be provided and fastened to the message panel with concealed fasteners.

2.1.4 Character Proportions and Heights

Letters and numbers on indicated signs which do not designate permanent rooms or spaces shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 3 inches.

2.1.5 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms)

Raised and brailled characters and symbols are only required on signs that designate permanent rooms or spaces, including restrooms and room numbers. They are not required for information or way-finding signs. Raised letters and numbers on signs must protrude 1/32 inch upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 inch in height, but no higher than 2 inches. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inches minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

2.2 BUILDING DIRECTORIES

Building directories shall be lobby directories or floor directories, and shall be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. Dimensions, details, and materials of sign and message content shall be as shown on the drawings, attachments, and signage placement schedule.

2.2.1 Header Panel

Header panel shall have background metal to match frame and shall have raised letters be ES/MP plastic with raised letters.

2.2.2 Doors

2.2.2.1 Door Glazing

Door glazing shall be in accordance with ASTM C 1036, Type 1, Class 1, Quality 3, minimum 1/8 inch thick, clear acrylic sheet 3/16 inch thick conforming to clear polycarbonate sheet 3/16 inch thick.

2.2.2.2 Door Construction

Extruded aluminum door frame shall be of same finish as surrounding frame. Corners shall be mitered, reinforced, welded, and assembled with concealed fasteners. Hinges shall be standard with the manufacturer, in finish to match frames and trim. Glazing shall be set in frame with resilient glazing channels.

2.2.2.3 Door Locks

Door locks shall be manufacturer's standard, and shall be keyed alike.

2.2.3 Fabrication

Extruded aluminum frames and trim shall be assembled with corners reinforced, welded and mitered to a hairline fit, with no exposed fasteners.

2.2.4 Illuminated Units

Illuminated directory units shall have concealed internal top, back lighting with rapid start fluorescent tube lamp, internal wiring, and lead at wire for connection. Electrical work shall comply with NFPA 70 and shall be UL or FM listed.

2.2.5 Negative Graphics Directory System

Directory shall consist of internally illuminated unit with backlit photo negative directory strips and a black background. Unit shall have a tinted tempered safety solar glass door. Design of unit shall be as shown.

2.2.5.1 Construction

The directory shall be constructed of an aluminum 6 inch deep frame with satin black or dark bronze anodized finish. Unit shall be fully recessed mounted. Unit shall have a 3 inch high header lettering as shown. Unit shall have a 3/8 inch face door frame with concealed hinges and locking system. Door frame shall be aluminum as indicated.

2.2.5.2 Message Strips

Message strips shall be photo negative type updatable by user with book reordering and with 7 to 10 day delivery. Message strips shall be as indicated.

2.2.6 Changeable Letter/Message Strip Directory System

Directory shall consist of an internally illuminated or a non-illuminated unit with step or groove, laser or rotary engraved removable name strips cast vinyl to receive molded changeable letter tiles. Design of unit shall be as shown in the drawings.

2.2.6.1 Construction

The directory shall be constructed of an aluminum 2 inch deep frame with satin anodized finish. Unit shall be surface, semi, or fully recessed mounted. Unit shall have a 3 inch high header with lettering as shown. Unit shall have a 3/8 inch face concealed hinge door and locking system with tempered safety glass fixed frame. Door frame shall be aluminum with satin as indicated.

2.3 METAL PLAQUES

2.3.1 Cast Metal Plaques

2.3.1.1 Fabrication

Cast metal plaques shall have the logo, emblem and artwork cast in the bas relief or flat relief technique. Plaques shall be fabricated from prime aluminum , bronze, or yellow brass.

2.3.1.2 Border

Border shall be as indicated.

2.3.1.3 Background

Background texture shall be as indicated.

2.3.1.4 Mounting

Mounting shall be concealed or invisible.

2.3.1.5 Finish

Finishes shall consist of aluminum light colored sandblasted background. Letters shall be satin polished and entire plaque shall be sprayed with two coats of clear lacquer.. Letters shall be satin polished and entire plaque sprayed with two coats clear lacquer or bronze with dark finish oxidized background. Letters shall be satin polished and entire plaque sprayed with two coats of clear lacquer or aluminum with background sprayed with standard color. Letters shall be satin polished.

2.3.2 Chemically Etched Metal Plaques

2.3.2.1 Fabrication

Plaque shall be chemically double- etched one-piece brass or bronze 0.125 inch thick.

2.3.2.2 Finish

Double-etched raised areas shall be gold-tone or silver-tone and recessed textured areas shall be gold-tone or silver-tone colorfilled.

2.3.3 Frost and Surface Oxidized Plaques

2.3.3.1 Fabrication

Plaque shall be frosted and surface oxidized one-piece anodized aluminum, brass, or bronze 0.125 inch thick.

2.3.3.2 Finish

Material finish shall be satin or polished. Frosted areas shall be oxidized black for aluminum or stainless steel or black or brown, for brass or bronze.

2.4 DIMENSIONAL BUILDING LETTERS

2.4.1 Fabrication

Letters shall be fabricated from cast aluminum or cast bronze 0.125 inch aluminum sheet or extruded aluminum. Letters shall be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters shall be packaged for protection until installation.

2.4.2 Typeface

Typeface shall be helvetica medium.

2.4.3 Size

Letter size shall be as indicated.

2.4.4 Finish

Anodized aluminum Baked enamel Polished Oxidized bronze with clear coat finish shall be provided.

2.4.5 Mounting

Threaded studs of number and size recommended by manufacturer, shall be supplied for concealed anchorage. Letters which project from the mounting surface shall have stud spacer sleeves. Letters, studs, and sleeves shall be of the same material. Templates for mounting shall be supplied.

2.5 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions shall be at least 1/8 inch thick, and aluminum plate or sheet shall be at least 0.0508 inch thick. Extrusions shall conform to ASTM B 221; plate and sheet shall conform to ASTM B 209. Where anodic coatings are specified, alloy shall conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes shall be as shown. Welding for aluminum products shall conform to AWS D1.2/D1.2M.

2.6 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

Integral color anodized designation AA-M10-C22-A32, Architectural Class 0.4 to 0.7 mil.

Electrolytically deposited color-anodized designation AA-M10-C22-A34, Architectural Class II 0.4 to 0.7 mil.

2.7 ORGANIC COATING

Organic coating shall conform to AAMA 2604, with total dry film thickness not less than 1.2 mils.

2.8 FABRICATION AND MANUFACTURE

2.8.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.8.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.9 COLOR, FINISH, AND CONTRAST

Color shall be in accordance with Section 09 06 90 COLOR SCHEDULE as indicated on the drawings. Finish of all signs shall be eggshell, matte, or other non-glare finish as required in handicapped-accessible buildings.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the detail drawings, schedule below, attachments. Mounting height shall be 60 inch above the finish floor to the centerline of the sign. Distance from edge of door frame to edge of sign shall be as indicated on drawings. Required blocking shall be installed. Signs shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 3 inches of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for

the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions.

-- End of Section --

SECTION 10 22 13

WIRE MESH PARTITIONS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3 (2002) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (2005) Standard Specification for Carbon Structural Steel

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wire mesh partitions

Show layout, details, materials, dimensions, finishes, and all information necessary for fabrication and installation.

SD-03 Product Data

Wire mesh partitions

Submit for each type of partition, door, and window.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials in manufacturer's original, unopened containers or packaging with labels intact and legible. Deliver, store, and handle materials so as to prevent damage. Replace damaged or defective materials with new.

1.4 DESCRIPTION OF WORK

Wire mesh partitions shall be all wire type, sheet metal base type, normal duty for normal industrial use, heavy duty for extra heavy industrial use, and shall be provided complete with fasteners, capping bars, adjustable floor sockets, bracing, doors, service windows, hardware, and other items necessary for a complete, useable, and rigid installation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Shapes, Plates, and Bars

ASTM A 36/A 36M.

2.1.2 Cold-Formed Steel

AISI SG03-3.

2.1.3 Wire Mesh

Carbon steel wire, woven diamond mesh, intermediate crimped.

2.1.4 Floor Sockets

Cast or forged steel or ductile iron, adjustable, approximately 2 1/2 inches high.

2.2 NORMAL DUTY PARTITIONS

2.2.1 Wire Mesh

10 gage wire, 1 1/2 inch mesh.

2.2.2 Vertical Frames

1 1/4 by 5/8 inch cold-rolled C section channels or 1 1/4 by 5/8 by 1/8 inch channels. Provide only C channels where frames are installed toe to toe without posts.

2.2.3 Horizontal Frames

One by 5/8 inch channels.

2.2.4 Center Reinforcing Bar

One one by 1/2 by 1/8 inch channel with all wires woven through, or two one by 3/8 by 1/8 inch channels bolted together with mesh in between.

2.2.5 Capping Bar

2 1/4 by one by 1/8 inch channel or 2 by 1/4 inch flat bar.

2.2.6 Corner Posts

Structural steel angles, 1 1/4 by 1 1/4 by 1/8 inch.

2.2.7 Line Posts

Unless otherwise indicated, provide partitions more than 12 feet high with flat bar line posts bolted between vertical frame channels. Sizes of posts shall be as follows:

Partition Height	Size of Posts
12 feet to 14 feet 8 inches	1 3/4 by 5/16 inch or

Partition Height	Size of Posts 2 by 1/4 inch
14 feet 8 inches to 19 feet 8 inches	2 1/2 by 5/16 inch
19 feet 8 inches to 23 feet 8 inches	3 by 5/16 inch

2.2.8 Hinged Doors

Frames shall be 1 1/4 by 1/2 by 1/8 inch channels with 1 1/4 by 1/8 inch flat bar cover on top and bottom rails and on hinge stile and a 1 3/8 by 3/4 by 1/8 inch angle riveted to the lock stile. Provide 1 1/2 pairs of regular weight, wrought steel, non-removable pin, butt hinges riveted or welded to the door and the door opening frame for each door.

2.2.9 Sheet Metal Base

Hot- or cold-rolled sheet steel, not lighter than 16 gage.

2.3 HEAVY DUTY PARTITIONS

2.3.1 Wire Mesh

6 gage wire, 2 inch mesh.

2.3.2 Panel Frames

1 1/2 by 3/4 by 1/8 inch steel channels.

2.3.3 Center Reinforcing Bar

One 1 1/2 by 3/4 by 1/8 inch channel with all wires woven through, or two 1 1/4 by 3/8 by 1/8 inch channels bolted together with mesh in between.

2.3.4 Capping Bar

Structural steel channel, 3 inch by 4.1 pounds.

2.3.5 Corner Posts

Structural steel angles, 1 3/4 by 1 3/4 by 1/8 inch.

2.3.6 Line Posts

Unless otherwise indicated, provide partitions with flat bar line posts bolted between vertical frame channels. Sizes of posts shall be as follows:

Partition Height	Size of Posts
7 feet to 12 feet	2 1/2 by 5/16 inch
12 feet to 16 feet	3 by 5/16 inch or 2 1/2 by 3/8 inch
16 feet to 20 feet	3 1/2 by 5/16 inch

2.3.7 Hinged Doors

Frames shall be 1 1/2 by 3/4 by 1/8 inch channels with 1 1/2 by 1/8 inch

flat bar cover on top and bottom rails and on hinge stile and a 1 5/8 by 7/8 by 1/8 inch angle riveted to the lock stile. Provide 1 1/2 pairs of heavyweight, wrought steel, non-removable pin, butt hinges riveted or welded to the door and the door opening frame for each door.

2.4 SLIDING DOORS

Frames shall be 1 1/2 by 3/4 by 1/8 inch channels with 1 1/2 by 1/8 inch flat bar cover all around. Provide two four-wheel, roller bearing hangers and steel box track for each door.

2.5 DOOR OPENING FRAMES

Provide frames the same size and shape as the vertical frames for the mesh panels.

2.6 LOCKS

Provide each door with a mortise type lock with a six-pin tumbler lock cylinder on the outside and a recessed knob on the inside.

2.7 SERVICE WINDOWS

Slide up type, mounted in standard mesh panel reinforced with channel tracks. Opening shall be 24 inches wide by 15 inches high unless otherwise indicated. Provide two spring loaded latches, operable only from the inside, to lock window in open and closed positions. Form shelf of 12 gage sheet steel, 12 inches deep by 25 inches wide, unless otherwise indicated.

2.8 FABRICATION

2.8.1 Standard Panels

Wire shall be woven into diamond mesh, intermediate crimped, and securely clinched to frames. Joints shall be mortised and tenoned. Wire shall be continuous at center reinforcing bars, either woven through a single channel or bolted between two channels. Panel vertical frames shall have 3/8 inch bolt holes 18 inches o.c. for heavy duty partitions.

2.8.2 Sheet Metal Base Panels

Upper portion shall be as specified for standard panels, except that the wire shall be clinched into the center reinforcing bar. Form sheet steel to fit between the panel frames and securely bolt to the frames.

2.8.3 Doors and Service Windows

Construction shall be similar to that specified for panels. Wire mesh shall be the same as that used in the adjacent partition panels.

2.8.4 Finish

Thoroughly clean ferrous metal, treat with phosphate, and paint with gray enamel in the shop.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wire Mesh Partitions

Install plumb, level, and true to line, within a tolerance of 1/8 inch in 10 feet or the height or run of the partition, if less than 10 feet. Anchor floor sockets to the floor with expansion bolts. Vertical frames and posts shall be bolted together with 3/8 inch bolts 18 inches o.c. for heavy duty partitions. Secure top frames to a continuous capping bar with 1/4 inch diameter U bolts not more than 28 inches o.c.

3.1.2 Doors and Service Windows

Install in accordance with the manufacturers' recommendations. Adjust as required so that doors, windows, and hardware operate freely and properly.

3.1.3 Bracing

Brace free standing partitions more than 20 feet in length, at intervals not greater than 20 feet with a structural steel I section or tube post welded to a 9 by 9 inch steel base plate anchored to the floor with 4 expansion bolts or as indicated.

3.1.4 Touch-Up

Clean and paint scratches, abrasions, and other damage to shop painted surfaces to match the shop-applied finish.

-- End of Section --

SECTION 10 28 13

TOILET ACCESSORIES

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036	(2006) Standard Specification for Flat Glass

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes
Accessory Items

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

SD-04 Samples

Finishes
Accessory Items

One sample of each accessory proposed for use. Incorporate approved samples into the finished work, provided they are identified and their locations noted.

SD-07 Certificates

Accessory Items

Certificate for each type of accessory specified, attesting that the items meet the specified requirements.

SD-10 Operation and Maintenance Data

Electric Hand Dryer

Four complete copies of maintenance instructions listing routine maintenance procedures and possible breakdowns. Include repair instructions for simplified wiring and control diagrams and other

information necessary for unit maintenance.

1.3 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.4 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories shall be provided where indicated in accordance with paragraph SCHEDULE. Porcelain type, tile-wall accessories are specified in Section 09 30 00 CERAMIC TILE QUARRY TILE, AND PAVER TILE. Provide each accessory item shall be complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamperproof design, oval heads exposed fasteners with finish to match the accessory.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below.

2.2.1 Facial Tissue Dispenser (FTD)

Provide surface, recessed mounted facial tissue dispenser, Type 304 stainless steel face, satin finish, bright polished finish. Secure face of recessed dispenser by friction with suitable spring steel clips. Provide a minimum capacity of 150, 200, 300 two-ply tissues for dispenser.

2.2.2 Grab Bar (GB)

Provide an 18 gauge, 1-1/4 inch grab bar OD Type 304 stainless steel. Provide form and length for grab bar as indicated. Provide concealed, exposed mounting flange. Provide grab with satin finish, peened non-slip surface. Furnish installed bars capable of withstanding a 500 pound

vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 1-1/2 inch space between wall and grab bar.

2.2.3 Medicine Cabinet (MC)

Construct medicine cabinet with cold-rolled carbon steel sheet of minimum 0.03 inch thickness, formed from a single sheet of steel or mechanically formed and spot welded. Provide width, height and depth of cabinet in accordance with paragraph SCHEDULE.

2.2.3.1 Sliding Door Cabinet, Class 1

Provide surface mounted vanity, recessed cabinet, sliding door cabinet assembly with design and lighting arrangement as indicated. Provide a minimum of 2 shelves per cabinet. Provide a wide, a narrow, no frame mirror.

2.2.3.2 Swinging Door Cabinet, Class 2

Furnish swinging door cabinet assembly, including the lighting arrangement, as indicated. Provide surface, recess, mounted assembly. Locate cabinet centrally behind the door with a minimum of two shelves. Provide stainless steel or carbon steel door hinges. Provide permanent type magnets used in door catches. Provide doors with, without a mirror.

2.2.4 Mirrors, Glass (MG)

Provide Type I transparent flat type, Class 1-clear glass for mirrors. Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Coat glass on one surface with silver coating, copper protective coating, and mirror backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.5 Mirror, Metal (MM)

Provide a brightly polished stainless steel metal mirror of 0.037 inch minimum thickness, edges turned back 1/4 inch and recess fitted with tempered hardboard backing, and theft-proof fasteners. Provide size in accordance with paragraph SCHEDULE.

2.2.6 Mirror, Tilt (MT)

Provide surface mounted tilt mirror with full visibility for persons in a wheelchair. Furnish adjustable, fixed tilt mirror, extending at least 4 inch from the wall at the top and tapering to 1 inch at the bottom. Provide size in accordance with the drawings. Conform to ASTM C 1036 and paragraph Glass Mirrors.

2.2.7 Paper Towel Dispenser (PTD)

Provide _____ paper towel dispenser constructed of a minimum 0.03 inch Type 304 stainless steel, surface mounted. Furnish tumbler key lock locking

mechanism.

2.2.8 Combination Paper Towel Dispenser/Waste Receptacle (PTDWR)

Provide semi-recessed dispenser/receptacle with a capacity of 600 sheets of C-fold, single-fold, or quarter-fold towel. Design waste receptacle to be locked in unit and removable for service. Provide tumbler key locking mechanism. Provide waste receptacle capacity of 12 gallons. Fabricate a minimum 0.03 inch stainless steel welded construction unit with all exposed surfaces having a satin finish. Provide waste receptacle that accepts reusable liner standard for unit manufacturer.

2.2.9 Sanitary Napkin Disposer (SND)

Construct a Type 304 stainless steel sanitary napkin disposal with removable leak-proof receptacle for disposable liners. Provide fifty disposable liners of the type standard with the manufacturer. Retain receptacle in cabinet by tumbler lock. Provide disposer with a door for inserting disposed napkins, surface mounted.

2.2.10 Sanitary Napkin and Tampon Dispenser (SNTD)

Provide sanitary napkin and tampon dispenser surface mounted. Dispenser, including door of Type 304 stainless steel that dispense both napkins and tampons with a minimum capacity of 20 each. Furnish dispensing mechanism for complimentary operation. Hang doors with a full-length corrosion-resistant steel piano hinge and secure with a tumbler lock. Provide keys for coin box different from the door keys.

2.2.11 Shower Curtain (SC)

Provide shower curtain, size to suit conditions. Provide anti-bacterial nylon/vinyl fabric curtain. Furnish color as shown in Section 09 06 90 COLOR SCHEDULE.

2.2.12 Shower Curtain Rods (SCR)

Provide Type 304 stainless steel shower curtain rods 1-1/4 inch OD by 0.049 inch minimum straight to meet installation conditions.

2.2.13 Soap Dispenser (SD)

Provide soap dispenser surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.14 Soap Holder (SH)

Provide surface mounted Type 304 stainless steel soap holder. Provide stainless steel separate supports.

2.2.15 Shelf, Metal, Heavy Duty (SMHD)

Furnish a minimum 18 gauge stainless steel heavy duty metal shelf with hemmed edges. Provide shelves over 30 inch with intermediate supports. Provide minimum of 16 gauge supports, welded to the shelf, and spaced no more than 30 inch apart.

2.2.16 Shelf, Metal, Light Duty (SMLD)

Support light duty metal shelf between brackets or on brackets. Purpose of brackets is to prevent lateral movement of the shelf. Furnish 18 inch or 24 inch long shelf. Provide stainless steel shelf and brackets.

2.2.17 Soap and Grab Bar Combination, Recessed (SGR)

Provide recessed type, Type 304 stainless steel soap and grab bar combination satin finish.

2.2.18 Towel Bar (TB)

Provide stainless steel towel bar with a minimum thickness of 0.015 inch. Provide minimum 3/4 inch diameter bar, or 5/8 inch square. Provide satin finish.

2.2.19 Towel Pin (TP)

Provide towel pin with concealed wall fastenings, and a pin integral with or permanently fastened to wall flange with maximum projection of 4 inch. Provide satin finish.

2.2.20 Toilet Tissue Dispenser (TTD)

Furnish Type II - surface mounted toilet tissue holder with two rolls of standard tissue mounted horizontally. Provide stainless steel, satin finish cabinet.

2.2.21 Toilet Tissue Dispenser, Jumbo (TTDJ)

Provide surface mounted toilet tissue dispenser with 2 rolls of jumbo tissue. Fabricate cabinet of Type 304, 18 gauge stainless steel with Type 304, 20 gauge stainless steel door. Provide cover with key lock.

2.2.22 Toothbrush and Tumbler Holder (TTH)

Provide stainless steel, surface mounted toothbrush and tumbler holder. Furnish holder to hold a minimum of four toothbrushes in a vertical position. Provide 2-1/4 plus or minus 1/8 inch in diameter size of hole for securing tumbler.

2.2.23 Waste Receptacle (WR)

Provide Type 304 stainless steel waste receptacle, designed for surface mounting. Provide reuseable liner, of the type standard with the receptacle manufacturer. Provide a minimum 18 gallon capacity. Provide receptacles with push doors and doors for access to the waste compartment with continuous hinges. Furnish tumbler key lock locking mechanism.

2.2.24 Toilet Seat Cover Dispenser (TSCD)

Provide Type 304 stainless steel with surface mounted toilet seat cover dispensers. Provide dispenser with a minimum capacity of 500 seat covers.

2.2.25 Toilet Seat Cover/Tissue Dispenser/Waste Receptacle (TSCTDWR)

Provide stainless steel and partition mounted, recessed mounted, surface mounted toilet seat cover, tissue dispenser, and waste receptacle

combination. Provide a minimum of 500 seat covers and 2 standard tissue rolls for each dispenser. Provide a waste receptacle of the reuseable liner of type standard with the receptacle manufacturer.

2.2.26 Electric Hand Dryer (EHD)

Provide wall mount and electric hand dryer designed to operate at 110/125 volts, 60 cycle, single phase alternating current with a heating element core rating of a maximum 2100 watts. Provide dryer housing of single piece construction and of chrome plated steel.

2.2.27 Diaper Changing Station (DCS)

Provide surface mounted diaper changing station fabricated of high impact plastic with no sharp edges. Provide fold down platform concave to the child's shape, equipped with nylon and velcro safety straps and engineered to withstand a minimum static load of 340 lb. Provide an integral dispenser for sanitary liners for each unit. Provide pictorial for universal use of safety graphics.

PART 3 EXECUTION

3.1 INSTALLATION

Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone or polysulphide sealant) as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do mot use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

-- End of Section --

SECTION 10 44 16

FIRE EXTINGUISHERS

06/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL CODE COUNCIL (ICC)

IFC 1414	(2004) Portable Fire Extinguishers(Where Required)(Construction, Alteration, Demolition)
IFC 906	(2004) Portable Fire Extinguishers

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1	(2006) Uniform Fire Code, 2006 Edition
NFPA 10	(2006; Errata 2006) Standard for Portable Fire Extinguishers
NFPA 101	(2005; Errata 2006; TIA 2006; TIA 2006) Life Safety Code, 2006 Edition
NFPA 505	(2006) Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.157	(2003) Portable Fire Extinguishers

UNDERWRITERS LABORATORIES (UL)

UL 154	(2005; Rev thru Sep 2007) Standards for Carbon Dioxide Fire Extinguishers
UL 2129	(2005; Rev thru Jan 2007) Standards for Halocarbon Clean Agent Fire Extinguishers
UL 299	(2002; Rev thru Aug 2007) Standards for Dry Chemical Fire Extinguishers
UL 8	(2005; Rev thru Sep 2007) Standards for Water Base Agent Fire Extinguishers

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Data for each type of required Fire Extinguisher with all related details, cabinets, accessories, and recommended operation manuals.

SD-02 Shop Drawings

Submit fabrication drawings for the following items consisting of fabrication and assembly details to be performed in the factory. Submit installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Fire Extinguishers
Accessories
Cabinets
Wall Brackets

SD-03 Product Data

Submit Manufacturer's catalog and warranty data for the following items:

Fire Extinguishers
Accessories
Cabinets
Wall Brackets
Replacement Parts

SD-04 Samples

One Fire Extinguisher of each type to be installed

One full-sized sample of each type of Cabinet to be installed

Three samples of Wall Brackets and Accessories of each type to be used

Approved samples may be used for installation, with proper identification and storage.

SD-07 Certificates

Submit Certificates showing the following:

Certification that Fire Extinguishers comply with local codes and regulations.

Certification that Fire Extinguishers comply with OSHA, NFPA, and UL requirements.

Submit Manufacturer's Warranty with Inspection Tag on each extinguisher.

Guarantee that Fire Extinguishers are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than 5 years after completion.

1.3 DELIVERY, HANDLING, AND STORAGE

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

Provide portable fire extinguishers in compliance with NFPA 505 for all ancillary vehicles where Fire Safety Standard for Powered Industrial Trucks, including type designations, special c conditions relating to areas of use, conversions, maintenance, or specific operations apply.

PART 2 PRODUCTS

2.1 TYPES

Fire Extinguishers must conform to NFPA 10 Quantity and placement must comply with the applicable sections of IFC 1414, IFC 906, NFPA 1, NFPA 101, and 29 CFR 1910.157.

Provide carbon-dioxide type fire extinguishers compliant with UL 154.

Provide dry chemical type fire extinguishers compliant with UL 299.

Provide wet chemical type fire extinguishers compliant with UL 8.

Provide clean agent type fire extinguishers compliant with UL 2129.

Provide dry powder type fire extinguishers.

Submit Manufacturer's Data for each type of Fire Extinguisher required, detailing all related Cabinet, Wall Mounting and Accessories information, complete with Manufacturer's Warranty with Inspection Tag.

2.2 MATERIAL

Extinguisher shell must be corrosion-resistant steel, aluminum, or enameled steel.

2.3 SIZE

Extinguishers must be 10 pounds or as indicated.

2.4 CABINETS

2.4.1 Material

Provide enameled steel or aluminum cabinets.

2.4.2 Type

Provide recessed, trimless, or surface type cabinets.

2.4.3 Size

Dimensions of cabinets must be of adequate size to accommodate the specified fire extinguishers.

2.5 WALL BRACKETS

Provide wall-hook fire extinguisher wall brackets.

Wall bracket and Accessories must be as approved.

PART 3 EXECUTION

3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation.

Comply with the manufacturer's recommendations for all installations.

Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers complete with Manufacturer's Warranty with Inspection Tag attached.

3.2 ACCEPTANCE PROVISIONS

3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Provide Replacement Parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

SECTION 10 51 13

METAL LOCKERS

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1008/A 1008M	(2007a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 568/A 568M	(2007) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(2007) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D 2092	(1995; R 2001e1) Standard Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-L-00486	(Rev J) Lockers, Clothing, Steel

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Types

Location

Installation

Numbering system

SD-03 Product Data

Material

Locking Devices

Lock Control Chart

Handles

Finish

Locker components

Assembly instructions

SD-04 Samples

Color chips

1.3 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Protect from weather, soil, and damage during delivery, storage, and construction.

1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication. Verify correct location

1.5 QUALITY ASSURANCE

1.5.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color scheduled, indicated.

Government may request performance-characteristic tests on assembled lockers. Tests and results must conform to FS AA-L-00486. Lockers not conforming will be rejected.

PART 2 PRODUCTS

2.1 TYPES

Locker must have the following type and size in the location and quantities indicated. Locker finish colors will be as scheduled.

2.1.1 Single-tier Lockers

Single-tier lockers must be as follows:

Type STC-2: Single-tier locker 15 inches wide, 18 inches deep, and 72 inches high, attached to 6-inch high closed base or as indicated.

2.1.2 Double-Tier

Double-tier lockers must be as follows:

Type DTC-2: Double-tier locker 15 inches wide, 18 inches deep, and 72 inches high, attached to a 6-inch high closed base or as indicated.

2.2 MATERIAL

2.2.1 Galvanized Steel Sheet

ASTM A 1008/A 1008M or ASTM A 568/A 568M, commercial quality, minimized spangle material. Prepare material surfaces for baked enamel finishing in accordance with FS AA-L-00486.

ASTM A 653/A 653M and ASTM A 924/A 924M, commercial quality, minimized spangle, galvanized steel sheet with not less than G60 zinc coating. Prepare surface of sheet for painting in accordance with ASTM D 2092, Method A. Minimum uncoated sheet thickness as specified.

2.2.2 Finish

FS AA-L-00486.

2.2.2.1 Color

As selected.

2.3 COMPONENTS

2.3.1 Built-In Locks

FS AA-L-00486. Provide locking devices as a padlock eye in the door latching mechanism.

2.3.2 Coat Hooks

FS AA-L-00486, zinc plated.

2.3.3 Hanger Rods

FS AA-L-00486.

2.3.4 Door Handles

FS AA-L-00486. Provide zinc alloy or steel handles with a chromium coating.

2.3.5 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

2.3.5.1 Hinges

In addition to the requirements of FS AA-L-00486, provide 5-knuckle hinges, minimum 2 inches high. Fabricate knuckle hinges from not less than 0.0787 inch thick steel sheet. A full height piano hinge may be provided if standard with the manufacturer. Weld or bolt hinges to the door frame. Weld, bolt, or rivet hinges to the door.

2.3.5.2 Latching Mechanisms

FS AA-L-00486.

2.3.6 Latch Strikes

FS AA-L-00486. Fabricate from not less than 0.0787 inch thick steel sheet, except latch strike may be continuous from top to bottom and fabricated as part of the door framing.

2.3.7 Silencers

FS AA-L-00486.

2.3.8 Back and Side Panels, Tops, and Bottoms

FS AA-L-00486, not less than 0.0474 inch thick steel sheet.

2.3.9 Sloping Locker Tops

Provide sloping locker tops in addition to the locker-section flat tops. Sloping tops must be continuous in length. Provide fillers or closures at the exposed end of sloping tops. Fabricate sloping tops from not less than 0.0478-inch thick steel sheet.

2.3.10 Shelves

FS AA-L-00486. Fabricate from not less than 0.0598 inch thick steel sheet.

2.3.11 Number Plates

FS AA-L-00486. Aluminum. Provide consecutive numbers.

2.3.12 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Secure lockers to wall and base with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively with odd numbers on top and even numbers on bottom as indicated.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

SECTION 12 21 00

WINDOW BLINDS

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	(2004) Fire Tests for Flame Propagation of Textiles and Films

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-02 Shop Drawings

Hardware
Installation

Drawings showing fabrication and installation details. Show layout and locations of track, direction of draw, mounting heights, and details.

SD-03 Product Data

Window Blinds
Hardware
Installation

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

SD-04 Samples

Window Blinds
Hardware
Valance

Samples of each type and color of window treatment. Provide plastic horizontal louver blind slats 6 inch in length for each color. Track must be 6 inch in length. Shade material must be minimum 6 by 6 inch in size.

SD-06 Test Reports

Window Blinds

Fire resistance, Flame Spread, and smoke contribution data.

SD-08 Manufacturer's Instructions

Window Blinds

SD-10 Operation and Maintenance Data

Window Blinds

1.3 GENERAL REQUIREMENTS

Provide window treatment, conforming to NFPA 701, complete with necessary brackets, fittings, and hardware. Each window treatment type must be a complete unit provided in accordance with paragraph WINDOW TREATMENT PLACEMENT SCHEDULE. Mount and operate equipment as per manufacturer's instructions. Windows to receive a treatment must be completely covered.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required.

1.5 FIELD MEASUREMENTS

Become familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Provide each blind, including hardware, accessory items, mounting brackets and fastenings, as a complete unit produced by one manufacturer. All parts must be one color, unless otherwise indicated, to match the color of the blind slat. Treat steel features for corrosion resistance.

2.1.1 Horizontal Blinds

Provide horizontal blinds with 1 inch slats Blind units must be capable of nominally 180 degree partial tilting operation and full-height raising. Blinds must be inside mount. Furnish tapes for Type I slats with longitudinal reinforced vinyl plastic in 1-piece turn ladder construction. Tapes for Type II slats must be braided polyester or nylon.

2.1.1.1 Head Channel and Slats

Provide head channel made of steel or aluminum with corrosion-resistant

finish nominal 0.024 inch for Type II. Provide slats of aluminum, not less than 0.006 inch thick, and of sufficient strength to prevent sag or bow in the finished blind. Provide a sufficient amount of slats to assure proper control, uniform spacing, and adequate overlap. Enclose all hardware in the headrail.

2.1.1.2 Controls

The slats must be tilted by a transparent tilting wand, hung vertically by its own weight, and must swivel for easy operation. The tilter control must be of enclosed construction. Provide moving parts and mechanical drive made of compatible materials which do not require lubrication during normal expected life. The tilter must tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats. Include a mechanism to prevent over tightening. Provide a wand of sufficient length to reach to within 5 feet of the floor.

2.1.1.3 Intermediate Brackets

Provide intermediate brackets for installation, as recommended by the manufacturer, of blinds over 48 inch wide.

2.1.1.4 Bottom Rail

Provide bottom rail made of steel, corrosion-resistant, with baked-on polyester paint, color coordinated with slats, and formed with a double-lock seam into a closed oval shape for optimum strength. Provide end caps to match the rail in color.

2.1.1.5 Hold-Down Brackets

Provide universal type hold-down brackets for sill or jamb mount where indicated on placement list.

2.1.1.6 Audio Visual Blinds

In addition to requirements for blinds, each unit must include light traps at sides, and sill. Furnish privacy blinds which provide light enhancing capabilities by means of hidden slat holes. Construct light traps from aluminum or sheet steel, not less than 0.02 inch thick, U-shaped, with legs not less than 1.75 inch long for Type I blinds. Round or bead edges in contact with blinds. Finish inside surfaces of light traps in a dull gray or black color.

2.1.2 Vertical Blinds

2.1.2.1 Controls

Provide tilting and traversing controls that hang compactly at the side of the blinds and reach within 5 feet of the floor. The tilt/traverse control must tilt all vanes simultaneously to any desired angle and hold them at that angle. Provide louvers that traverse one way to the right one way to the left. The traversing control cord must be minimum 0.070 inch in diameter with a minimum breaking strength of 125 pounds. Provide louvers that traverse along the headrail by pulling one side of the looped cord fastened to a cord tension pulley or a fiberglass wand that tilts the louvers by turning the wand and traverses the louvers by using the wand as a drapery control.

2.1.2.2 Connectors and Spacers

The connector must be flexible, smooth and flat to slide unhindered when carriers move independently of each other, and to nest compactly when carriers are stacking. The length of the links must relate to the louver width in order to equally space the traversing louvers, to maintain uniform and adequate overlap of louvers, and to fully cover the width of the opening.

2.1.2.3 Intermediate Brackets

Furnish intermediate installation brackets for blinds over 62 inches wide.

2.2 COLOR

Provide color, pattern and texture as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 IDENTIFICATION

In accordance with the numbering plan, mark each opening and the corresponding window treatment with identical numbers. For multiple windows separated by mullions, the space required by each blind must be numbered separately. Use brass, aluminum, plastic, durable paper plates, or stamp to place corresponding numbers on unexposed surfaces of openings and inside or on top of the headrail track.

3.2 INSTALLATION

3.2.1 Horizontal Blinds

Perform installation in accordance with the approved detail drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Furnish and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

3.2.2 Audio Visual Blinds

Perform installation in accordance with the approved detail drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Furnish and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

3.3 CLEAN-UP

Upon completion of the installation, free window treatments from soiling, damage or blemishes; and adjust them for form and appearance and proper operating condition. Repair or replace damaged units as directed by the Contracting Officer. Isolate metal parts from direct contact with

concrete, mortar, or dissimilar metals. Ensure blinds installed in recessed pockets can be removable without disturbing the pocket. The entire blind, when retracted, must be contained behind the pocket. For blinds installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --

SECTION 12 32 00

MANUFACTURED WOOD CASEWORK

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(2004) Basic Hardboard

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1	(1999) Standard for Mat-Formed Wood Particle Board

ASME INTERNATIONAL (ASME)

ASME B18.6.1	(1981; R 1997) Wood Screws (Inch Series)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1008/A 1008M	(2007a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 325	(2007a) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2007) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 366/A 366M	(1997e1) Standard Specification for Commercial Steel, Sheet, Carbon,(0.15 Maximum Percent Cold-Rolled
ASTM C 1036	(2006) Standard Specification for Flat Glass
ASTM D 13	(2002) Standard Specification for Spirits of Turpentine

ASTM D 4689 (1999; R 2005) Standard Specification for Adhesive, Casein-Type

ASTM D 4690 (1999; R 2005) Standard Specification for Urea Formaldehyde Resin Adhesives

ASTM F 594 (2002) Standard Specification for Stainless Steel Nuts

ASTM F 836M (2002) Standard Specification for Style 1 Stainless Steel Metric Nuts

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9 (2003) Cabinet Hardware

HARDWOOD PLYWOOD & VENEER ASSOCIATION (HPVA)

HPVA HP-1 (2004) American National Standard for Hardwood and Decorative Plywood

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC (2003; Errata 2003; Errata 2004; Errata 2004; Errata 2005) International Plumbing Code

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA A161.1 (2000) Performance & Construction Standards for Kitchen and Vanity Cabinets

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (2005) Standard for High-Pressure Decorative Laminates

NEMA LD 3.1 (1995) Performance, Application, Fabrication, and Installation of High-Pressure Decorative Laminates

SCIENTIFIC EQUIPMENT AND FURNITURE ASSOCIATION (SEFA)

SEFA 7 (1996) Recommended Practice for Laboratory and Hospital Service Fittings

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1 (1995) Construction and Industrial Plywood (APA V995)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-B-588 (Rev E) Bolt, Toggle: and Expansion Sleeve, Screw

FS FF-S-325 (Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices,

	Anchoring, Masonry)
FS MM-L-736	(1983c) Lumber; Hardwood
FS MM-L-751	(Rev H) Lumber; Softwood
FS TT-C-490	(1990; Am 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
FS TT-C-520	(Rev B; Am 1) Coating Compound, Bituminous, Solvent Type, Underbody (for Motor Vehicles)
FS TT-E-489	(Rev J; Notice 1) Enamel, Alkyd, Glass, Low VOC Content
FS TT-E-491	(Rev C) Enamel; Gloss, Synthetic (for Metal and Wood Furniture)
FS TT-F-336	(Rev E) Filler, Wood, Paste
FS TT-V-121	(Rev H) Varnish, Spar, Water-Resisting
FS WW-P-541	(1990e; Am 1) Plumbing Fixtures

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit fabrication drawings for steel and wood cabinets in accordance with the paragraphs entitled, "Wood Cabinet, Steel Cabinet, Counter Top and Back Splash Fabrication," of this section.

Submit Installation Drawings for steel and wood cabinets in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Cabinets
Corrosion-Resistant Steel
Plywood
Hardwood
Glass
Adhesives
Filler Material
Particle Board
Turpentine
Varnish
Fasteners
Steel Sinks
Service Fixtures
Accessories and Hardware

Softwoods
Plastic Laminate
Countertops

SD-04 Samples

Samples must include:

Accessories and Hardware, one each.

Submit Manufacturer's Standard Color Charts in accordance with paragraph entitled, "General," of this section.

SD-07 Certificates

Submit certificates for the following items showing conformance with the referenced standards contained in this section.

Corrosion-Resistant Steel
Plywood
Hardwood
Glass
Adhesives
Filler Material
Particle Board
Turpentine
Varnish
Fasteners
Steel Sinks
Service Fixtures
Accessories and Hardware

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for in accordance with paragraph entitled, "General," of this section.

1.3 DELIVERY, STORAGE, AND HANDLING

Cabinets must be delivered, stored, and handled in a manner that will prevent damage and disfigurement.

1.4 DESIGN

Cabinets must be wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Construct cabinets as specified and meet the requirements of KCMA A161.1. Wall and base cabinet assemblies must consist of individual units joined into continuous sections. Accomplish fastenings to permit removal and replacement of individual units without affecting the remainder of the installation. Provide counters with watertight sink rim when indicated. Drawers must be removable and will be equipped with position stops to avoid accidental complete withdrawals. Fix or adjust shelves as indicated.

PART 2 PRODUCTS

2.1 GENERAL

Submit Manufacturer's Standard Color Charts for wood and metal cabinets showing the manufacturer's recommended color and finish selections.

Submit Manufacturer's Instructions for wood and metal cabinet systems including special provisions required to install equipment components and system packages. Special notices must detail impedances, hazards and safety precautions.

Cabinets must be the manufacturer's standard sizes of type and design indicated. Provide both wall and base cabinet assemblies will consisting of individual units joined into continuous sections as indicated. Provide fastenings to permit removal and replacement of individual units without affecting the remainder of the installation.

2.2 MATERIALS

Steel for cabinet construction must conform to ASTM A 1008/A 1008M.

Corrosion-Resistant Steel must conform to ASTM A 167, Type 302, 304, 316 Finish 4.

Douglas-fir Plywood must conform to ICC IPC, exterior type, fully waterproof bond.

Glass must conform to ASTM C 1036, Type I, Class 1, Quality q3,1/4 inch thick, for unframed sliding glass doors; other glass must conform to ASTM C 1036, Type II, Class 1, Quality q8, 7/32 inch thick.

Adhesives for application of plastic laminate must be a thermosetting urea-resin Type II conforming to ASTM D 4690 as recommended by the manufacturer of the laminate. Adhesive for wood members will conform to ASTM D 4689.

Filler Material must conform to FS TT-F-336.

Hardwood must conform to FS MM-L-736, standard hardwood lumber, S2S.

Hardwood plywood must conform to ICC IPC.

Particle Board must conform to ANSI A208.1, Type 1, Grade M or medium density.

Provide Plastic Laminate conforming to NEMA LD 3.

Provide Softwoods conforming to FS MM-L-751, factory and shop grade.

Provide Turpentine conforming to ASTM D 13.

Provide Varnish conforming to FS TT-V-121.

Provide Accessories and Hardware conforming to the following requirements, as applicable:

Extension drawer slides: BHMA A156.9, Type B85071

Semiconcealed hinges: BHMA A156.9, Type B81201, 1-1/2 inches

Full surface hinges: BHMA A156.9, Type B81131, 1-1/2 inches

Knob pulls: BHMA A156.9, 1-inch diameter, Type B12132

Bar type pulls: BHMA A156.9, 4-inch overall length, Type B12012

Semiconcealed hinges: BHMA A156.9, Type B81201, 40 millimeter

Full surface hinges: BHMA A156.9, Type B81131, 40 millimeter

Knob pulls: BHMA A156.9, 25 millimeter diameter, Type B12132

Bar type pulls: BHMA A156.9, 100 millimeter overall length, Type B12012

Locks, keying, and keys: As directed

Catches: Magnetic, 5-pound pull

Sliding door set:

Impregnated fiberboard track

Nylon glides

Fasteners must conform to the following:

Screws: ASME B18.6.1, Group, Type and Class as applicable

Anchoring Devices: FS FF-S-325, Group, Type, and Class as applicable

Toggle bolts: FS FF-B-588, Type I, Class A, Style 2

Nuts: ASTM F 594, corrosion-resistant steel

Bolts: ASTM A 325, heavy, hexagon head bolts corrosion-resistant steel

Nuts: ASTM F 836M, corrosion-resistant steel

Bolts: ASTM A 325M, heavy, hexagon head bolts corrosion-resistant steel

Corrosion-resistant Steel Sinks:

18-gage corrosion-resistant steel, integral with corrosion-resistant steel countertop

Drain holes in center of bowl

Underside coated with 1/8-inch thick sound deadener

Die-form, seamless, raised edges at front and ends

Cove corners to 1/2-inch radius

Equip with strainers and tail pieces

Sound deadening must conform to FS TT-C-520.

Service Fixtures must conform to the following requirements:

Provide fixtures in accordance with the water conservation policy as stated in the Standard Plumbing Codes, Appendix J.

Faucets: splashback mounted, cast brass, chrome plated, FS WW-P-541

Faucets: deck mounted, cast brass, chrome plated, FS WW-P-541

Gas, air, and vacuum, distilled water, steam, and de-ionized water cocks: cast brass, chrome plated, ground key type

Drains, strainers, and taps: brass, chrome plated, FS WW-P-541

Index buttons: plastic, color codes in accordance with SEFA 7

Special items: nipples and locknuts with each fixture will be as directed.

Metal pretreatment coatings: FS TT-C-490, Type I

Metal pretreatment coatings: FS TT-C-490, Type II

Metal pretreatment coatings: FS TT-C-490, Type III

Enamel: FS TT-E-491, Class 2

2.3 WOOD CABINET FABRICATION

Wall and base cabinets must be essentially of same construction and same outside appearance. Construct cabinets with frame fronts and solid ends, or frame construction throughout. Frame members must be3/4-by 1-1/2-inch kiln-dried hardwood, using mortise and tenon, dovetailed or doweled, and glued together. Brace top and bottom corners with hardwood blocks that are glued with water-resistant glue and nailed in place. Provide base cabinets with an integral toe space at least 2-1/2 inches deep and 4 inches high. Mount drawers on metal guides. Shelves must be removable and adjustable, as indicated.

Minimum thicknesses of materials for frame-front, solid-end cabinet construction will be as follows:

Backs and bottoms of base cabinets and tops of wall cabinets: 1/8-inch tempered hardboard. Brace bottoms with wood members glued in place.

Cabinet ends: 1/2-inch hardwood-veneer plywood

Doors: 3/4-inch hardwood plywood, solid core doors

Drawer fronts: 3/4-inch hardwood

Drawer bottoms: 3/16-inch plywood or tempered hardboard. Drawer bottoms over 1 foot 3 inches wide will be braced with wood members glued in place.

Drawer sides and backs: 1/2-inch hardwood

Interior partitions or dividers: 1/2-inch fir plywood, Grade A-A, hardwood

Shelves: Grade A-B plywood, supported on ends and 24 inches on centers

Adjustable shelves: 3/4-inch plywood

Base cabinet shelves: 5/8-inch plywood

Wall cabinet shelves: 1/2-inch plywood glued-up solid wood

Minimum thicknesses of materials for frame-type cabinet construction must be as follows:

Cabinet ends: 1/4-inch hardwood plywood

Backs, bottoms, partitions, and dividers: 3/16-inch tempered hardboard in a frame

Materials for other components must be as specified.

2.3.1 High-Pressure Decorative Laminate (HPDL)

NEMA LD 3, satin finish, unless otherwise indicated.

2.3.1.1 Countertops

PF 42, satin finish.

2.3.1.2 Vertical Surfaces

GP 28 or PF 30, satin finish.

2.3.1.3 Backing Sheet

BK 20.

2.3.1.4 Cabinet Liner

CL 20.

2.3.2 Hardwood Plywood

HPVA HP-1, Type II (Interior), three- or five-ply, with face veneer of good grade (1) or better. Cover all exposed edges.

2.3.3 Hardwood

All exposed wood surfaces must be hardwood of species consistent with specified finish. Species used need not be that indicated by finish named, but must be similar in grain character and appearance.

2.3.4 Softwood Plywood

PS1.

2.3.4.1 Countertops

Exterior type, A-C Grade.

2.3.4.2 Elsewhere

Interior type, A-B Grade, may be used in lieu of hardwood plywood where HPDL finish is provided.

2.3.5 Hardboard

AHA A135.4, tempered.

2.3.6 Steel for Cabinets

ASTM A 366/A 366M, cold rolled, commercial quality carbon steel sheet.

2.3.7 Sinks, Lavatories and Fittings

As specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.4 PARTICLE BOARD CABINET FABRICATION

Wall and base cabinets must be essentially of same construction and covered with plastic laminate as indicated. Construct cabinets with frame fronts and solid ends throughout. Frame members will be3/4-by 1-1/2-inch kiln-dried hardwood, using mortise and tenon, dovetailed or doweled, and glued together. Brace top and bottom corners with hardwood blocks that are glued with water-resistant glue and nailed in place. Provide base cabinets with an integral toe space at least 2-1/2 inches deep and 4 inches high. Mount drawers on metal guides, hardwood guides, renewable plastic or fiber guides. Shelves must be fixed, removable and adjustable, as indicated.

Minimum thicknesses of materials for cabinet construction must be as follows:

Backs and bottoms of base cabinets and tops of wall cabinets: 3/16-inch tempered hardboard. Brace bottoms with wood members glued in place.

Cabinet ends: 3/4-inch particle board with a plastic laminate covering

Doors: 3/4-inch particle board laminated on front surface, rear surface, all edges

Drawer fronts: 3/4-inch particle board laminated on all edges

Drawer bottoms: 1/8-inch plywood or tempered hardboard. Brace drawer bottoms over 1 foot 3 inches wide with wood members glued in place.

Drawer sides and backs: 1/2-inch particle board

Interior partitions or dividers: 1/2-inch particle board

Shelves: Supported on ends and 24 inches on centers

Adjustable shelves: 3/4-inch particle board

Base cabinet shelves: 5/8-inch particle board

Wall cabinet shelves: 1/2-inch particle board

2.5 PLYWOOD CABINET FABRICATION

Wall and base cabinets must be essentially of same construction and covered with plastic laminate as indicated. Construct cabinets with frame fronts and solid ends throughout. Frame members will be3/4-by 1-1/2-inch kiln-dried hardwood, using mortise and tenon, dovetailed or doweled, and glued together. Brace top and bottom corners with hardwood blocks that are glued with water-resistant glue and nailed in place. Provide base cabinets with an integral toe space at least 2-1/2 inches deep and 4 inches high. Mount drawers on metal guides. Shelves must be removable and adjustable, as indicated.

Minimum thicknesses of materials for cabinet construction must be as follows:

Backs and bottoms of base cabinets and tops of wall cabinets: 3/16-inch tempered hardboard. Brace bottoms with wood members glued in place.

Cabinet ends: 3/4-inch standard veneer-core plywood with a plastic laminate covering

Doors: 3/4-inch standard veneer-core plywood laminated on front surface, rear surface, all edges

Drawer fronts: 3/4-inch standard veneer-core plywood laminated on all edges

Drawer bottoms: 1/8-inch plywood or tempered hardboard. Brace drawer bottoms over 1 foot 3 inches wide with wood members glued in place.

Drawer sides and backs: 3/4-inch standard veneer-core plywood

Interior partitions or dividers: 34-inch standard veneer-core plywood

Shelves: Supported on ends and 24 inches on centers

Adjustable shelves: 3/4-inch standard veneer-core plywood

Base cabinet shelves: 3/4-inch standard veneer-core plywood

Wall cabinet shelves: 3/4-inch standard veneer-core plywood

2.6 LAMINATE CABINET FABRICATION

Wall and base cabinets must be essentially of same construction and covered with plastic laminate as indicated. Construct cabinets with frame fronts and solid ends throughout. Frame members will be 3/4-by 1-1/2-inch kiln-dried hardwood, using mortise and tenon, dovetailed or doweled, and glued together. Brace top and bottom corners with hardwood blocks that are glued with water-resistant glue and nailed in place. Provide base cabinets with an integral toe space at least 2-1/2 inches deep and 4 inches high. Mount drawers on metal guides. Shelves must be removable and adjustable, as indicated.

Minimum thicknesses of materials for cabinet construction must be as follows:

Backs and bottoms of base cabinets and tops of wall cabinets:

3/16-inch tempered hardboard. Brace bottoms with wood members glued in place.

Cabinet ends: 3/4-inch standard veneer-core plywood with a plastic laminate covering

Doors: 3/4-inch low pressure laminate

Drawer fronts: 3/4-inch low pressure laminate

Drawer bottoms: 1/8-inch plywood or tempered hardboard. Brace drawer bottoms over 1 foot 3 inches wide with wood members glued in place.

Drawer sides and backs: 3/4-inch standard veneer-core plywood

Interior partitions or dividers: 3/4-inch standard veneer-core plywood

Shelves: Supported on ends and 24 inches on centers

Adjustable shelves: 3/4-inch standard veneer-core plywood

Base cabinet shelves: 3/4-inch standard veneer-core plywood

Wall cabinet shelves: 3/4-inch standard veneer-core plywood

2.7 MISCELLANEOUS CABINETS

2.7.1 Combination Sink-and-Base Cabinet

A combination sink-and-base cabinet unit may be furnished in lieu of the base cabinet and inset sink indicated provided the combination unit affords facilities and space equal to those indicated and provided the combination unit matches the adjacent units in materials and construction. Sink, with matching drainboards, must be corrosion-resistant steel and will be equipped with a chromium-plated swinging-spout faucet, chromium-plated water-control valves, and chromium-plated cup strainer. Make joints between sink and drainboard and between drainboard and counter top watertight.

2.7.2 Special Purpose Cabinets

Special-purpose cabinets, such as cabinets for eye-level oven units, countertop range units, and built-in refrigerators and desks, must be furnished as indicated and will be of same materials and construction as adjacent cabinets. Provide space adjacent to sink for a dishwasher, as indicated.

2.8 ACCESSORIES AND HARDWARE

Furnish accessories such as utility shelves and racks for extracts, condiments, and towels; bins for sugar and flour; breadboxes; and trays for cutlery and flatware as indicated.

Hardware must be corrosion resistant. Exposed hardware must have a chromium-plated finish or a corrosion-resistant finish as approved. Paint semiconcealed hinges on cabinets where paint finish is required to match the cabinets. Equip doors with bullet-type catches, spring hinges, magnetic-type catches. Provide door and drawer pulls as indicated.

2.9 CABINETS

The work includes providing new factory-finished kitchen wall and base cabinets with high pressure decorative laminate (HPDL) countertops and bathroom vanity cabinets with HPDL countertops to receive combination lavatory-countertops as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. The cabinets must conform to KCMA A161.1, requirements specified herein, and bear the "KCMA Certified Cabinet" seal of the Kitchen Cabinet Manufacturers Association. In lieu of this, manufacturer must submit test reports from an approval laboratory that cabinets meet requirements of KCMA A161.1. Provide Countertops conforming to NEMA LD 3.1 and requirements specified herein.

2.9.1 Frame Type Cabinets

Construct the cabinets with frame construction throughout. Frame members must be 3/4 inch thick by 1-1/2 inch wide; kiln-dried hardwood, glued together, and must be either mortised and tenoned, dovetailed or doweled, nailed, stapled or screwed. Brace top and bottom corners with either hardwood blocks that are glued together with water resistant glue and nailed in place, or metal or plastic corner braces. Backs of wall cabinets will be 1/8 inch thick plywood, tempered hardboard or 3/8 inch thick, 44 pound density particle board. Backs of base and tall cabinets must be 3/8 inch thick hardwood or 3/8 inch thick, 44 pound plywood. Bottoms of cabinets must be minimum 3/4 inch thick plywood 44 pound density particle board or good grade plywood and will be braced with wood members glued in place. Cabinet ends must be 5/8 inch thick hardwood plywood.

2.9.2 Frameless Type Cabinets

The cabinets must be of frameless design and construction. Construct cabinets of minimum 5/8 inch thick, 45 pound plywood laminate end and floor panels. Construct cabinet back of minimum 3/16 inch thick, 45 pound plywood laminate. Dowel and glue hanging rails to end panels, then fastened and hot melt glued to cabinet back. Toe kick plates must be recessed, doweled and glued to the end panels. Brace top and bottom corners with either hardwood blocks glued together with water resistant glue and nailed in place, or fastened with metal or plastic corner braces.

2.10 FINISH

2.10.1 Cabinet Finish

Provide cabinets with a factory-applied durable finish in accordance with KCMA A161.1 requirements and of a type standard with the manufacturer. Fabricate natural finish wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides of wood which will be free of extreme color variations within each panel or between adjacent panels. Exposed exterior surfaces must be hardwood or grade A-A hardwood veneer with natural stain and sprayed on factory applied finish. Paint-finished wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides fabricated of hardwood or grade C hardwood veneer or vinyl wrap.

2.10.2 Backer Sheets

Backer Sheets of high pressure plastic laminate, must conform to NEMA LD 3, Grade BK20 and must be applied to the underside of all core material.

2.11 COLOR, TEXTURE, AND PATTERN

Color must be in accordance with Section 09 06 90 COLOR SCHEDULE and as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 FIELD FINISHING OF WOOD CABINETS

For painted finish, apply a prime coat and two coats of synthetic enamel of air-drying quality, conforming to FS TT-E-489, Class A. Colors must be as selected.

For natural finish, the applicable procedure for the type of wood must be followed:

For open-grain woods: Apply one coat of paste wood filler, and remove excess filler. Then apply one coat of pale varnish thinned with turpentine, followed by one coat of pale varnish and then by one coat of satin-finish varnish, plus an additional coat of satin-finish varnish on cabinet doors and drawer fronts. Lightly sand surfaces between coats.

For close-grain woods: Apply one coat of pale varnish thinned with turpentine, followed by one coat of pale varnish and then by one coat of satin-finish varnish, plus an additional coat of satin-finish varnish on cabinet doors and drawer fronts. Lightly sand surfaces between coats.

At the Contractor's option, wood cabinets with a factory finish standard set by the cabinet manufacturer may be provided.

3.2 INSTALLATION

Install casework plumb with countertops level to within 1/16 inch in 10 feet. Level base cabinets by adjusting leveling screws. Scribe and fit scribe strips to irregularities of adjacent surfaces. Gap opening must not exceed.

Secure cases permanently to floor and wall construction using 1/4-inch diameter masonry anchors, spaced 30 inches maximum on center, minimum of two for each case.

Support wall cases on continuous 18-gage galvanized steel hanging brackets. Secure wall cases in position with screws to blocking. Bolt adjoining cases together. Width of joints must not exceed 1/32 inch. Provide closer strips, filler strips, and finish moldings as required. Doors must be aligned, hardware adjusted, and surfaces cleaned and waxed.

Submit Installation Drawings for steel and wood cabinets. Drawings must include location of cabinets, details of cabinets related and dimensional positions, and locations for roughing in plumbing, including sinks, faucets, strainers and cocks.

3.3 CLEANING

On completion of cabinet installation, touch up marred or abraded finished surfaces. Remove crating and packing materials from premises. Wipe down surfaces to remove fingerprints and markings and leave in clean condition.

3.4 INSPECTION

Examine casework grounds and supports for adequate anchorage, foreign material, moisture, and unevenness that could prevent quality casework installation. Ensure that electrical and plumbing rough-ins for casework are complete. Do not proceed with installation until defects are corrected.

-- End of Section --

SECTION 12 36 00

COUNTERTOPS

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B18.6.1	(1981; R 1997) Wood Screws (Inch Series)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1008/A 1008M	(2007a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 325	(2007a) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2007) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM D 13	(2002) Standard Specification for Spirits of Turpentine
ASTM D 2583	(2007) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D 4689	(1999; R 2005) Standard Specification for Adhesive, Casein-Type
ASTM D 4690	(1999; R 2005) Standard Specification for Urea Formaldehyde Resin Adhesives
ASTM D 570	(1998; R 2005) Standard Test Method for Water Absorption of Plastics
ASTM D 638	(2003) Standard Test Method for Tensile Properties of Plastics

ASTM E 84	(2007b) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 594	(2002) Standard Specification for Stainless Steel Nuts
ASTM F 836M	(2002) Standard Specification for Style 1 Stainless Steel Metric Nuts

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO Z124.3	(1995) Plastic Lavatories

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2003; Errata 2003; Errata 2004; Errata 2004; Errata 2005) International Plumbing Code

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA A161.1	(2000) Performance & Construction Standards for Kitchen and Vanity Cabinets

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

SCIENTIFIC EQUIPMENT AND FURNITURE ASSOCIATION (SEFA)

SEFA 7	(1996) Recommended Practice for Laboratory and Hospital Service Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-B-588	(Rev E) Bolt, Toggle: and Expansion Sleeve, Screw
FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS MM-L-736	(1983c) Lumber; Hardwood
FS MM-L-751	(Rev H) Lumber; Softwood
FS TT-C-490	(1990; Am 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
FS TT-C-520	(Rev B; Am 1) Coating Compound, Bituminous, Solvent Type, Underbody (for Motor Vehicles)
FS TT-E-491	(Rev C) Enamel; Gloss, Synthetic (for Metal and Wood Furniture)

FS TT-F-336	(Rev E) Filler, Wood, Paste
FS TT-V-121	(Rev H) Varnish, Spar, Water-Resisting
FS WW-P-541	(1990e; Am 1) Plumbing Fixtures

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit fabrication drawings for Counter Top and Back Splash Fabrication," of this section.

Submit Installation Drawings for Counter Top and Back Splash

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Corrosion-Resistant Steel
Plywood
Hardwood
Granite
Marble
Synthetic resins
Stainless steel
Tile
FRP
Adhesives
Filler Material
Particle Board
Turpentine
Varnish
Fasteners
Steel Sinks
Service Fixtures
Accessories and Hardware
Softwoods
Plastic Laminate

SD-04 Samples

Samples must include:

Counter Top and Back Splash, one each, 4 inches in width, submitted as one unit or as separate items.

Accessories and Hardware, one each.

Submit Manufacturer's Standard Color Charts in accordance with paragraph entitled, "General," of this section.

SD-07 Certificates

Submit certificates for the following items showing conformance

with the referenced standards contained in this section.

Corrosion-Resistant Steel
Plywood
Hardwood
Adhesives
Filler Material
Particle Board
Turpentine
Varnish
Fasteners
Steel Sinks
Service Fixtures
Accessories and Hardware

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for in accordance with paragraph entitled, "General," of this section.

1.3 DELIVERY, STORAGE, AND HANDLING

Countertops must be delivered, stored, and handled in a manner that will prevent damage and disfigurement.

1.4 DESIGN

Countertops must be wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Construct countertops as specified and meet the requirements of KCMA A161.1. Accomplish fastenings to permit removal and replacement of individual units without affecting the remainder of the installation. Provide counters with watertight sink rim when indicated. Drawers must be removable and will be equipped with position stops to avoid accidental complete withdrawals.

PART 2 PRODUCTS

2.1 GENERAL

Submit Manufacturer's Standard Color Charts for countertops showing the manufacturer's recommended color and finish selections.

Submit Manufacturer's Instructions for countertops including special provisions required to install equipment components and system packages. Special notices must detail impedances, hazards and safety precautions.

Countertops must be the manufacturer's standard type or as indicated on the drawings. Accomplish fastenings to permit removal and replacement of individual countertops without affecting the remainder of the installation.

2.2 MATERIALS

Steel for countertops construction must conform to ASTM A 1008/A 1008M.

Corrosion-Resistant Steel must conform to ASTM A 167, Type 302, 304, 316 Finish 4.

Douglas-fir Plywood must conform to ICC IPC, exterior type, fully

waterproof bond.

Adhesives for application of plastic laminate must be a thermosetting urea-resin Type II conforming to ASTM D 4690 as recommended by the manufacturer of the laminate. Adhesive for wood members will conform to ASTM D 4689.

Filler Material must conform to FS TT-F-336.

Hardwood must conform to FS MM-L-736, standard hardwood lumber, S2S.

Hardwood plywood must conform to ICC IPC.

Provide Plastic Laminate conforming to NEMA LD 3.

Provide Softwoods conforming to FS MM-L-751, factory and shop grade.

Provide Turpentine conforming to ASTM D 13.

Provide Varnish conforming to FS TT-V-121.

Fasteners must conform to the following:

Screws: ASME B18.6.1, Group, Type and Class as applicable

Anchoring Devices: FS FF-S-325, Group, Type, and Class as applicable

Toggle bolts: FS FF-B-588, Type I, Class A, Style 2

Nuts: ASTM F 594, corrosion-resistant steel

Bolts: ASTM A 325, heavy, hexagon head bolts corrosion-resistant steel

Nuts: ASTM F 836M, corrosion-resistant steel

Bolts: ASTM A 325M, heavy, hexagon head bolts corrosion-resistant steel

Corrosion-resistant Steel Sinks:

18-gage corrosion-resistant steel, integral with corrosion-resistant steel countertop

Drain holes in center of bowl

Underside coated with 1/8-inch thick sound deadener

Die-form, seamless, raised edges at front and ends

Cove corners to 1/2-inch radius

Equip with strainers and tail pieces

Sound deadening must conform to FS TT-C-520.

Service Fixtures must conform to the following requirements:

Provide fixtures in accordance with the water conservation policy as stated in the Standard Plumbing Codes, Appendix J.

Faucets: splashback mounted, cast brass, chrome plated, FS WW-P-541

Faucets: deck mounted, cast brass, chrome plated, FS WW-P-541

Gas, air, and vacuum, distilled water, steam, and de-ionized water cocks: cast brass, chrome plated, ground key type

Drains, strainers, and taps: brass, chrome plated, FS WW-P-541

Index buttons: plastic, color codes in accordance with SEFA 7

Special items: nipples and locknuts with each fixture will be as directed.

Metal pretreatment coatings: FS TT-C-490, Type I

Metal pretreatment coatings: FS TT-C-490, Type II

Metal pretreatment coatings: FS TT-C-490, Type III

Enamel: FS TT-E-491, Class 2

2.3 COUNTER TOP AND BACK SPLASH FABRICATION

Construct counter tops and back splash of plywood or wood covered with plastic laminate or Granite, Marble, Synthetic resins, Stainless steel Tile as indicated.

Plywood must be a water-resistant type, Grade B-D Douglas fir plywood, with a minimum thickness of 3/4 inch. Back splash must be plywood, hardwood, Granite, Marble, Synthetic resins, Stainless steel Tile 3/4-inch thick by the height indicated, and match the counter top.

Steel must be not lighter than 22-gage corrosion-resistant steel for backed construction and not lighter than 18-gage corrosion-resistant steel for integral construction. Reinforce steel tops on edges and around sink-rim opening. Counters will be of one-piece construction; where corrosion-resistant sink bowls are provided, joints must be welded and polished smooth. Make joints between sink, counter top, and back splash watertight. Provide backsplash of the same material as counter top and form with square edges. Height must be as indicated.

Plastic laminate must be continuous sheet of the longest length practicable and of the design and color selected. Provide joints in the surface sheeting that are tight and flush, and held to a practical minimum number.

Edging and trim:

For plastic-laminate-covered counter tops and back splash, the edging and trim must consist of:

Strips of laminate cut and fitted to exposed edges with contact adhesive

Corrosion-resistant steel molding applied to exposed edges and at the intersection of the top and back splash with a concealed fastening system

For corrosion-resistant steel counter tops and back splash, form

the edging and trim as an integral part of the top.

Sink rims must be standard products of a manufacturer regularly producing this type of equipment, and be fabricated from corrosion-resistant steel of the size necessary to receive the sinks.

2.3.1 High-Pressure Laminated Plastic Clad Countertops

Construct clad countertop and backsplash of 3/4 inch thick plywood and must be post formed cove type. Fully formed type or square edge must be a unit with shaped edges using wood nose molding at counter edge and include a separate backsplash. Backsplash must be not less than 3-1/2 inch high. Provide edging and trim that consists of plastic laminate cut and fitted to all exposed edges. Supply end splashes constructed of 3/4 inch plywood or 3/4 inch thick, 44 pound density particle board core. Provide continuous sheets of longest lengths practicable. Joints in surface sheeting must be tight and flush and held to a practicable minimum. When the countertop and backsplash are two separate units, use GP50 plastic laminate. When the countertop and backsplash are one unit, use PF42 plastic laminate. Provide plastic laminate conforming to the requirements of NEMA LD 3 and plastic laminate adhesive must be contact type applied to both surfaces. For fully formed and cove type countertops, the post-forming plastic laminate must not be bent to a radius smaller than the limit recommended by the plastic manufacturer.

2.3.2 Solid Polymer Countertops

Construct countertop and backsplash with integral sink and lavatory; as shown. Material must be 3/4 inch thickness, cast, and filled nonporous solid surfacing composed of acrylic polymer, mineral fillers, and pigments. Superficial damage to a depth of 0.010 inch must be repairable by sanding or polishing. Material must comply with the following performance requirements.

a. Tensile Strength; 4100 psi, when tested in accordance with ASTM D 638.

b. Hardness; Barcol Impressor 50 when tested in accordance with ASTM D 2583.

c. Flammability; rated Class I with a flame spread of 25 maximum and a smoke developed of 100 maximum when tested in accordance with ASTM E 84.

d. Boiling water resistance; no effect when tested in accordance with NEMA LD 3.

e. High temperature; no effect when tested in accordance with NEMA LD 3.

f. Liquid absorption; 0.06 percent maximum (24 hours) when tested in accordance with ASTM D 570.

g. Sanitation; National Sanitation Foundation approval for food contact in accordance with Standard 51 and approval for food area applications.

h. Impact resistance; no failure for ball drop when tested in accordance with NEMA LD 3.

2.3.3 Solid Polyester Resin Cultured Marble Countertops

Construct countertop and backsplash with integral sink and lavatory; as shown. Material must be 3/4 inch thickness, cast, and filled nonporous solid surfacing composed of polyester resin crushed marble, glass frit, mineral fillers and pigments. Material must comply with IAPMO Z124.3 and the following performance requirement. Flammability must comply with Class I, flame spread of 25 maximum and a smoke developed of 100 maximum when tested in accordance with ASTM E 84.

2.4 SURFACING

2.4.1 Laminated Plastic Surfacing

Laminate plastic sheeting to faces and exposed edges of particle board at 20 pounds per square inch and 185 degrees F.

Apply backing sheet to concealed faces.

2.4.2 Corrosion-Resistant Steel Surfacing

Form counters and work surfaces of 16-gage sheets with exposed edges returned.

Use hat-shaped channels, 16-gage, for reinforcement, spaced 30 inches on center.

Equip surfaces with wood strips under edges for fastening to cabinets.

Cove internal corners to 1/2-inch radius.

Coat underside with 1/8-inch thick sound deadener.

Joints must be electrically welded, ground smooth, and polished to match adjacent finish.

2.4.3 Wood Countertop Finish

Provide factory applied stained wood, clear coated natural finish, or HPDL finish as indicated on all internal and external surfaces.

2.4.3.1 Stained Wood Finish

As indicated. Internal surfaces must receive at least one coat of finish material.

2.4.3.2 HPDL Finish

Pattern and color: as indicated.

2.5 ACCESSORIES AND HARDWARE

2.5.1 Mounting Adhesives

Provide structural-grade silicone or epoxy adhesives of type recommended by manufacturer for application and conditions of use.

Provide spacers, if required, of type recommended by adhesive manufacturer.

2.5.2 Stone Adhesive

Provide epoxy or polyester adhesive of type recommend by manufacturer for application and conditions of use.

If adhesive will be visible in finished work, tint adhesive to match surfacing.

2.5.3 Joint Sealants

Use clear silicone sealant of type recommended by manufacturer for application and conditions of use.

Provide anti-bacterial type in toilet, bath rooms, and food preparation areas.

2.5.4 Solvent

Use a product recommended by adhesive manufacturer to clean surface of quartz surfacing to assure adhesion of adhesives and sealants.

2.5.5 Cleaning Agents

Use non-abrasive, soft-scrub type kitchen cleaners.

2.6 COLOR, TEXTURE, AND PATTERN

Color must be as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

Inspect material for defects prior to installation. Materials throughout project must be from the same batch and bear labels with the same batch number. Visually inspect materials to be used for adjacent pieces to assure acceptable color match. Inspect in lighting conditions similar to those on the project. Repair or replace damaged materials in a satisfactory manner.

Install countertops plumb with cabinetry level to within 1/16 inch in 10 feet. Level base cabinets by adjusting leveling screws. Scribe and fit scribe strips to irregularities of adjacent surfaces. Gap openings must not exceed.

Secure countertops to cabinetry and wall construction using 1/4-inch diameter masonry anchors, spaced 30 inches maximum on center.

Submit installation drawings for countertops. Drawings must include location of cabinets, details of cabinets related and dimensional positions, and locations for roughing in plumbing, including sinks, faucets, strainers and cocks.

3.1.1 Preliminary Installation and Adjustment

Install materials in accordance to manufacturer's recommendations. Lift and place to avoid breakage.

Position materials to verify that materials are correctly sized and prepared. Make necessary adjustments.

If jobsite cutting, grinding, or polishing is required, use water-cooled tools. Protect jobsite and surfaces against dust and water. Perform work away from installation site if possible.

3.1.2 Permanent Installation

After verifying fit, remove quartz surfacing from position, clean substrates of dust and contamination, and clean quartz surfacing back side and joints with solvent.

Apply sufficient quantity of mounting adhesive in accordance with adhesive manufacturer's recommendations to provide permanent, secure installation.

Install surfacing plumb, level, and square and flat to within 1/6 inch in 10 feet.

3.1.3 Joints

Joints between adjacent pieces of quartz surfacing:

Joints must be flush, tight fitting, level, and neat.

Securely join with stone adhesive. Fill joints level with quartz surfacing.

Clamp or brace quartz surfacing in position until adhesive sets.

Joints between backsplashes and countertops and around tub and shower enclosures: Seal joints with silicone sealer.

3.2 CLEANING

On completion of cabinet installation, touch up marred or abraded finished surfaces. Remove crating and packing materials from premises. Wipe down surfaces to remove fingerprints and markings and leave in clean condition.

3.3 INSPECTION

Examine casework grounds and supports for adequate anchorage, foreign material, moisture, and unevenness that could prevent quality casework installation.

Ensure that electrical and plumbing rough-ins for casework are complete. Do not proceed with installation until defects are corrected.

-- End of Section --

SECTION 12 93 00

SITE FURNISHINGS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 611	(1998) Voluntary Specification for Anodized Architectural Aluminum

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2005) Code of Standard Practice for Steel Buildings and Bridges
AISC 360	(2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE/SAFE A10.3	(2006) Operations - Safety Requirements for Powder Actuated Fastening Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C9	(2003) Plywood - Preservative Treatment by Pressure Processes
AWPA M2	(2001) Standard for Inspection of Treated Wood Products

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; Addenda A 1999; Errata 2003; R 2005) Square and Hex Bolts and Screws

(Inch Series)

ASME B18.2.2 (1987; R 2005) Standard for Square and Hex Nuts (Inch Series)

ASME B18.21.1 (1999; R 2005) Lock Washers (Inch Series)

ASME B18.22.1 (1965; R 2003) Plain Washers

ASME B18.6.2 (1998; R 2005) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series

ASME B18.6.3 (2003) Machine Screws and Machine Screw Nuts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M (2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 185/A 185M (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM A 307 (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 36/A 36M (2005) Standard Specification for Carbon Structural Steel

ASTM A 47/A 47M (1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A 48/A 48M (2003) Standard Specification for Gray Iron Castings

ASTM A 500/A 500M (2007) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 501 (2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

ASTM A 53/A 53M (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 615/A 615M (2007) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete

Reinforcement

ASTM A 653/A 653M	(2007) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B 108	(2006) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2006) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 26/B 26M	(2005) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 429/B 429M	(2006) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM B 62	(2002) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM C 1048	(2004) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 94/C 94M	(2007) Standard Specification for Ready-Mixed Concrete
ASTM C 979	(2005) Pigments for Integrally Colored Concrete
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 2990	(2001) Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
ASTM D 3451	(2006) Testing Coating Powders and Powder Coatings

ASTM D 4060	(2007) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4802	(2002) Poly(Methyl Methacrylate) Acrylic Plastic Sheet
ASTM D 648	(2007) Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM E 488	(1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F 1487	(2007ae1) Playground Equipment for Public Use

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(2003) Rules for the Measurement & Inspection of Hardwood & Cypress

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-117	(1996) Quality Control for Plants and Production of Architectural Precast Concrete Products
PCI MNL-128	(2001) Glass Fiber Reinforced Concrete Panels

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

RIS Grade Use	(1998) Redwood Lumber Grades and Uses

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	(2002) Standard Grading Rules for Southern Pine Lumber

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; E 2004) Paint Specification No. 25Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel Type I and Type II

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-1925	(Rev A; Notice 1) Shield, Expansion (Nail Anchors)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	(2000) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 (1998) Western Lumber Grading Rules

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Benches and Chairs
Tables
Shelters
Bicycle Racks
Planters
Bollards
Tree Grates
Assembly Assembly Instruction Drawings

Drawings showing scaled details of proposed site furnishings, elevations for each type of site furnishing; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction.

SD-03 Product Data

Benches and Chairs
Tables
Shelters
Bicycle Racks
Planters
Bollards
Tree Grates
Waste Receptacles

Manufacturer's descriptive data and catalog cuts.

SD-04 Samples

Finish

Two sets of color data for each furnishing displaying manufacturer's color selections and finishes, and identifying those colors and finishes proposed for use.

SD-06 Test Reports

Recycled Materials

A report of site furnishing parts consisting of recycled materials. Product specification data, providing test information for deflection and creep in accordance with ASTM D 648 and ASTM D 2990 for site furnishings which use plastic lumber as a component, shall be submitted. The data shall provide a comparison of deflection and creep measurements to other comparable materials.

Testing

A report of post-installation test results.

SD-07 Certificates

Primer certificate
Powder coatings certificate

Manufacturer's certificate of compliance.

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, INSPECTION, STORAGE AND PROTECTION

Materials shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. Site furnishings shall be inspected upon arrival at the job site for conformity to specifications and quality in accordance with paragraph MATERIALS. Protect from corrosion, staining, and other types of damage. Store items in designated area free from contact with soil and weather. Remove and replace damaged items with new items.

1.5 GENERAL REQUIREMENTS

1.5.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

11.5.2 Installation Drawings

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation.

1.5.3 Assembly Instruction Drawings

Submit assembly instruction drawings showing layout(s), connections, bolting and anchoring details as per manufacturer's standards.

1.5.4 Primer Certificate

Submit a certificate from the manufacturer stating that the primer conforms to requirements of SSPC Paint 25.

1.5.5 Powder Coatings Certificate

Submit a certificate from the manufacturer stating that the powder coat conforms to ASTM D 3451.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall be the standard products of a manufacturer regularly engaged in the manufacture of such products. The materials provided shall be of a type with proven satisfactory usage for at least 2 years.

2.1.1 Metals

Metallic materials and products shall conform to Section 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS. Metal components shall be furnished with factory drilled holes. Components shall be free of excess weld and spatter. Metal components with holes that will not be filled by hardware or hidden by other components will be rejected. Structural steel products shall conform to ASTM A 36/A 36M, ASTM A 500/A 500M and ASTM A 501.

2.1.2 Structural Tubing

ASTM A 500/A 500M.

2.1.3 Steel Pipe and Fittings

Steel pipe shall conform to ASTM A 53/A 53M, Type E or S, Grade B; standard malleable iron fittings shall conform to ASTM A 47/A 47M.

2.1.4 Gray Cast Iron

Gray cast iron shall conform to ASTM A 48/A 48M Class 35 or better. The Contractor shall provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.5 Cast Aluminum

Cast aluminum shall conform to ASTM B 26/B 26M and ASTM B 108. The Contractor shall provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.6 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.1.7 Anchors and Hardware

Anchors shall be provided, where necessary, for fastening site furnishings securely in place and in accordance with approved manufacturer's instructions. Anchoring devices that may be used, when no anchors are otherwise specified or indicated, include anchor bolts, slotted inserts, expansion shields for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; and lag bolts and screws for wood. Anchor bolts shall conform to ASTM A 307. Hardware shall be stainless steel, brass, zinc-plated, zinc-chromate plated or galvanized steel in accordance with ASTM A 153/A 153M and compatible with the material to which applied. All exposed hardware shall match in color and finish. Mounting hardware shall be concealed, recessed, and plugged.

2.1.7.1 Threaded Inserts and Expansion Anchors

Provide inserts recessed not less than 2.5 inches into concrete or masonry. Pullout 198 pounds in concrete with f'c of 3,000 psi, as tested per ASTM E 488. Expansion shields shall conform to FS A-A-1925, group II, type 4, class 1. Provide embeddment required by manufacturer.

2.1.7.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.7.3 Toggle Bolts

ASME B18.2.1.

2.1.7.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A 307.

2.1.7.5 Power Driven Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.7.6 Screws

ASME B18.2.1, ASME B18.6.2, and ASME B18.6.3.

2.1.7.7 Washers

Provide plain washers to conform to ASME B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.8 Ounce Metals

Bronze, copper, and other ounce metals shall conform to ASTM B 62.

2.1.9 Concrete

Ready-mixed concrete shall conform to ASTM C 94/C 94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Portland cement shall conform to ASTM C 150. Cast-in-place concrete materials and products shall conform to Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE or 03 30 00 CAST-IN-PLACE CONCRETE. Precast concrete material and products shall conform to Section 03 45 33 PRECAST STRUCTURAL CONCRETE. Reinforcing steel shall conform to ASTM A 615/A 615M. Welded wire fabric shall conform to ASTM A 185/A 185M.

2.1.10 Masonry

Masonry material and products shall conform to Section 04 20 00 MASONRY

2.1.11 Tempered Glass

ASTM C 1048, Kind FT (fully tempered), condition A (uncoated), Type 1 (transparent, Quality q3, 1/4 inch thick, clear in color.

2.1.12 Plastics

Recycled materials shall contain a minimum 85 percent recycled post-consumer product and shall conform to EPA requirements. Recycled materials shall be constructed or manufactured with a maximum 1/4 inch deflection or creep in any member in conformance with ASTM D 648 and ASTM D 2990. The Contractor shall provide panels and components molded of ultraviolet (UV) and color stabilized polyethylene, with minimum 1/4 inch wall thickness; exposed edges shall be smoothed, rounded, and free of burrs and points; and the material shall be resistant to fading, cracking, fogging, and shattering. The material shall be non-toxic and have no discernible contaminates such as paper, foil, or wood. The material shall contain no more than 3 percent air voids. Material shall be resistant to deformation from solar radiation heat gain. Recycled materials to include plastic lumber will not be used as structural components of site furnishings.

2.1.12.1 Extruded Acrylic Sheet

ASTM D 4802 Type I, regular 1/4 inch thick.

2.1.12.2 Cast Acrylic Sheet

ASTM D 4802, Item A, Type I, Heat resistant and ultraviolet light absorbing, 1/4 inch thick.

2.1.13 Lumber

The Contractor shall provide premium grade wood free of knots; boards with eased edges and ends; and wood components with factory drilled holes. Components with holes that will not be filled by hardware or hidden by other components will be rejected. Wood products shall be selected to withstand the climatic conditions of the region in which the site is located. Lumber grades shall meet manufacturers standards of the grading rules under which they are manufactured. Where no standards exist the following shall be the minimum acceptable grades for species used.

a. WWPA G-5 grading rules, Select or A & Btr. per special western red cedar rules.

b. WCLIB 17 standard grading rules, Douglas Fir, Western Cedars, A & Btr.

c. SPIB 1003 grading rules, Southern Pine, C & Btr.

d. NHLA Rules standard specification, Cypress, C-Select.

e. RIS Grade Use standard specifications, Redwood, Clear.

f. NHLA Rules rules, Cypress or Teak, Select or Btr.

2.1.13.1 Moisture Content

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products at time of delivery shall be as per manufacturers standard. If no manufacturer's standard exists, then moisture content shall be based on requirements for the product, grade and intended use.

2.1.13.2 Treatment

Wood that is not naturally rot and insect resistant shall be treated with standard procedures. Creosote, pentachlorophenol, tributyl tin oxide shall not be used in conformance with ASTM F 1487. Ammonium Copper Quat (ACQ) shall not be used for surfaces likely to contact the skin of small children. AWPA C1 and AWPA C9, as applicable, and inspected in accordance with AWPA M2.

2.1.13.3 Wood Seats and Table Tops

Clear teak, maple, oak, Jarrah, Ipe or other suitable hardwood, not less than 1-5/8 inches thick with rounded edges.

2.1.14 Fiberglass

Fiberglass shall consist of at least 3 laminations of chopped glass fibers impregnated with polyester resin, with colors and textures molded into all exposed surfaces so that colors resist fading. Fiberglass shall be resistant to cleaners, fertilizers, high power spray and salt.

2.2 PRETREATMENT, PRIMING AND PAINTING

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.1 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.2 Aluminum Surfaces

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.3 COATINGS AND FINISHES

2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing shall conform to ASTM A 123/A 123M, ASTM A 153/A 153M or ASTM A 653/A 653M, as applicable. Tailings and sharp protrusions formed as a result of the hot-dip process shall be removed and exposed edges burnished. Galvanize anchor bolts, grating fasteners, washers and parts or devices necessary for proper installation, unless otherwise indicated.

2.3.2 Polyester Powder

Powder-coated surfaces shall receive electrostatic zinc coating prior to painting. Powder coating shall be electrostatically applied and oven cured. Polyester powder coating shall be resistant to ultraviolet (UV) light.

2.3.3 Polyvinyl-Chloride (PVC)

PVC coating shall be primed with a clear acrylic thermosetting solution. The primed parts shall be preheated prior to dipping. The liquid polyvinyl chloride shall be ultraviolet (UV) stabilized and mold-resistant. The coated parts shall be cured. The coating shall be a minimum 2/25 inches thick plus or minus 0.020 inches and shall have an 85 durometer hardness with a slip-resistant finish.

2.3.4 Finish

Finish shall be as specified by the manufacturer or as indicated. Exposed surfaces and edges shall be rounded, polished, or sanded. Finish shall be non-toxic, non-glare, and resistant to corrosion. Exposed surfaces shall be smooth and splinter-free exposed surfaces.

2.3.4.1 Wood Sealants

Exposed wood surfaces shall have, as a minimum, two shop coats of paint, varnish, sealer, or other approved preservative. Sealants shall seal all applied surfaces from air.

2.3.4.2 Paint

Paint shall be factory applied with a minimum of 2 coats. Paint shall be weather-resistant and resistant to cracking, peeling and fading.

2.3.4.3 Color

Color of site furnishing components shall be in accordance with Section 09 06 90 COLOR SCHEDULE.

2.4 SITE STANDARDS

Site furnishings shall be furnished with the dimensions and requirements indicated. Site furnishings placed in children's outdoor play areas shall meet the safety requirements of ASTM F 1487 for entrapment; sharp points, edges, and protrusions; entanglement; pinch, crush, and shear points. Site furnishings to be included in children's outdoor play areas shall be free from sharp vertical edges and any protruding elements and designed with a minimum radius of 1/2 inch on all vertical edges; this includes, but is not limited to, seat walls, containment curbs and planters. Where practical, horizontal edges exposed to children's activities shall be rounded.

2.5 BENCHES AND CHAIRS

Benches and chairs shall be furnished with no sharp edges or protruding hardware.

a. Height: The height above finished grade or specified surface shall be between 18-20 inches and level.

b. Seat: The seat surface shall be pitched or slotted to shed water; the seat depth shall be between 12-18 inches and pitched down at the back at a 0-5 degree angle. Seat shall have a minimum width of 24 inches per person, and shall overhang the support base by a minimum of 4 inches for heel space and to facilitate rising from a seating position.

c. Back Rest: When back rests are required, the height shall be between 15-18 inches from the top of the seat and the connection shall be at a 90-110 degree angle to the seat.

d. Arm Rest: When arm rests are required, a minimum of 6 inches height from the seat and a minimum arm rest width of 1-1/2 inches shall be provided.

e. Weight Limit: Seats shall support a minimum 300 lbs for each person they are designed to accommodate.

2.5.1 Precast Units

Design precast units in accordance with manufacturer's standards, size as indicated. Finish and color as indicated selected from manufacturer's standards.

2.5.1.1 Glass Fiber Reinforced Concrete (GFRC) Units

Provide glass fiber reinforced concrete (GFRC) units at locations indicated on the drawings. Comply with PCI MNL-128 recommended practice for glass fiber reinforced concrete, including Appendix G, Polymer Modified Glass Fiber Reinforced Concrete Panels.

a. Design precast benches to sustain a live load of not less than 200 pounds per square foot.

b. Provide ASTM C 150 cement, use only one brand and type of cement throughout project.

c. Provide alkali resistant (AR) glass fibers produced specifically for use in glass fiber reinforced concrete, minimum three percent glass fiber content.

d. Provide clear silica sand aggregate passing No. 16 seive; washed, dried and free from deleterious materials. Provide type with successful history of uses in GFRC fabrication standard with the manufacturer.

e. Provide 3000 psi concrete, 28 day minimum compressive strength with approximately 120 pcf density; shell thickness of 3/8 to 5/8 inch.

f. Provide manufacturer's standard acrylic thermoplastic copolymer admixture.

g. Provide factory finished units standard with the manufacturer; texture and color as selected.

(1) Provide white or grey cement consistent with final finish.

(2) Provide ASTM C 33 (less gradation) facing aggregates, clean, hard, durable, inert and free of staining and deleterious materials; as required to match approved samples.

(3) Provide color meeting ASTM C 979, pure, non-fading mineral oxides, maximum ten percent cement weight; as required to match approved samples without impairing strength of GFRC.

(4) Apply finish meeting ASTM D 4060 waterborne crosslinked acrylic 49.5 +/- two percent solids by weight providing 1000 cycles per 0.001 inch resistance to abrasion.

h. Prefabricate units within following maximum fabrication tolerances.

(1) Dimension: Plus or minus 1/8 inch in any direction, noncumulative.

(2) Material Thickness: Plus 1/4 inch and minus 0-inch.

(3) Total Unit Thickness: Plus 1/4 inch and minus 1/8 inch.

(4) Insert Locations: Plus or minus 1/4 inch.

2.5.1.2 Precast Concrete/Cast Stone Units

Provide reinforced precast concrete units consisting of a mixture of cement, aggregates and mineral colors suitable for exterior use, located as shown on the drawings.

a. Design benches to sustain a live load of not less than 200 pounds per square foot.

b. Portland cement: ASTM C 150 Type I II or III.

c. Aggregate: ASTM C 33, maximum size 3/4 inch.

d. Reinforcing steel: ASTM A 615/A 615M.

e. Galvanized wire mesh: ASTM A 185/A 185M.

f. Integral color: ASTM C 979, pure mineral oxide, limeproof and non-fading.

g. Provide minimum 5000 psi 28 day compressive strength concrete, maximum five percent absorption.

h. Admixture: ASTM C 260 for air-entraining.

2.5.2 Wood Units

Provide manufacturer's standard wood units with wood, metal, fiberglass or concrete pedestals as indicated. Provide fasteners and accessories required for onsite assembly. Kiln dry and pressure treat wood components to manufacturer's standards. Pre-treat metal components and provide manufacturer's standard primer and powder coat finish complying with ASTM D 3451, color as selected. Provide fiberglass non-fading gel coat color as indicated. Provide manufacturer's standard exposed aggregate or sandblasted finish and protection coating on concrete pedestals.

a. Design wood benches to sustain a live load of not less than 200 pounds per square foot.

b. Provide kiln dried, surfaced four sides (S4S), clear all sides wood slats of species and sizes indicated.

(1) Species: Teakwood, Marine Teak, Red Cedar or Mahogany.

(2) Nominal wood slat sizes: 2 by 4 inch. Top and bottom rail may be larger in size and configuration for comfort of seating.

2.5.2.1 Support Pedestals

Provide cast iron, cast aluminum, concrete, fiberglass support pedestals as per manufacturer's standard.

a. Cast grey iron: ASTM A 48/A 48M Class 30 or recycled cast grey iron ASTM A 48/A 48M Class 25.

b. Cast aluminum: ASTM B 26/B 26M or ASTM B 108 as applicable.

c. Concrete shall be of the same quality and finish as specified for precast concrete.

d. Design fiberglass pedestals to support the loads imposed in design of bench. Color as approved.

2.5.2.2 Steel Arms

Provide 3/8 inch thick by 3 inch wide steel bench arms conforming to ASTM A 653/A 653M.

2.5.3 Fiberglass Benches

Provide reinforced fiberglass benches molded with multiple laminations of glass fiber impregnated with polyester isophthalic thermosetting resins, minimum thickness of 1/8 inch and reinforced as per manufacturer's standard practice.

a. Design bench to sustain a live load of not less than 200 pounds per square foot.

b. Provide manufacturer's finish, 12-15 mil color impregnated polyester gel coat, of color as selected from manufacturer's standard colors and finishes, smooth matte, orange peel, polished granite.

2.5.4 Steel Units

2.5.4.1 Perforated Steel

Provide 14 gage perforated steel sheet, electrostatically coated with two component polyester enamel.

a. Design bench to sustain a live load of not less than 200 pounds per square foot.

b. Provide 3/8 inch thick by 4 inch wide hot rolled steel pedestals conforming to ASTM A 653/A 653M.

c. Provide 1-1/2 inch O.D. ASTM A 53/A 53M schedule 40 steel pipe pedestals.

2.5.4.2 All-Welded Wire

Provide all-welded wire construction of 9 gage, 11 gage wire with 1/2 inch clear spacing and 5/16 inch wire with 2 1/2 inch spacing.

a. Design benches to sustain a live load of not less than 200 pounds per square foot.

b. Provide 1-1/2 inch O.D. by 16 gage galvanized tubing for bench frames.

c. Provide 1-1/2 inch O.D. by 11 gage galvanized tubing for armrest.

d. Provide cadmium or zinc plated hardware; nuts, bolts, screws, and lock washers with a clean chromate finish.

2.5.5 Aluminum Units

AA DAF-45 or AAMA 611. Provide extruded or formed aluminum benches as per manufacturers standard clear anodized or black anodized powder coat finish, color as selected from manufacturer's standards.

a. Design benches to sustain a live load of not less than 200 pounds per square foot.

b. Provide manufacturer's standard cast grey iron, cast aluminum, precast concrete, fiberglass pedestals.

2.5.6 Accessoriess

Provide manufacturer's standard materials and accessories as required for assembly of units and as indicated on the assembly drawings. Provide unexposed aluminum, stainless steel or steel plates, angles and supports as required for complete assembly. Separate dissimilar materials to prevent electrolytic action.

2.5.7 Fasteners

Provide concealed fasteners except where specifically approved; types as required for specific usage.

2.5.8 Anchoring Brackets

Provide 1/4 inch zinc plated steel angle anchoring brackets, 1-7/8 inch wide by 2 inches deep by 2-1/2 inches high 1-7/8 inch wide by 3-1/2 inch deep by 6 inch high, pre-drilled for bolting benches to substrate.

2.6 BICYCLE RACKS

Design bicycle racks (stanchions) in accordance with manufacturer's standards and to meet design conditions indicated. Locate as shown on the drawings. Provide powder coat finish in color as selected from manufacturer's standards. Racks shall accommodate locking devices and secure, as a minimum, one wheel and part of the frame simultaneously. The spacing between racks shall be a minimum of 24 inches.

2.6.1 Metal Pipe Bicycle Racks

Provide ASTM A 53/A 53M schedule 40 steel pipe bicycle racks in configuration and of 4-1/2 inch pipe size. Type of mounting, bicycle rack capacity and height above the ground as shown on the drawings.

2.6.2 Precast Concrete Bicycle Rack

Provide one-piece precast concrete bicycle rack base with embedded galvanized metal hitching loops. Design bicycle rack with wheel notches for bike support and wheel locking device.

2.7 BOLLARDS

2.7.1 Precast Concrete Bollards

Provide reinforced concrete bollards 12, 18 inch square, round, height as indicated, suitable for ground mount installation. Provide exposed aggregate or sandblast finish as indicated; manufacturer's standard clear acrylic sealer.

a. Portland cement: ASTM C 150 Type I II or III.

b. Aggregate: ASTM C 33, maximum size 3/4 inch.

c. Reinforcing steel: ASTM A 615/A 615M.

d. Integral color: ASTM C 979, pure mineral oxide, limeproof and non-fading.

e. Concrete strength: 5000 psi, 28 day minimum compressive strength.

f. Admixture: ASTM C 260 for air-entraining.

2.8 PLANTERS WASTE RECEPTACLES ASH RECEPTACLES

Provide for waste receptacles spun aluminum or reinforced fiberglass domed tops and removable semi-rigid plastic liner insert. Provide top-mounted ash trays for ash receptacles. Waste receptacles shall be furnished with weather protection, odor containment, and insect/animal-proofing. Container size shall be as directed.

a. Height: Trash and litter deposit openings shall be between 30-40 inches above the ground.

b. Liners: Trash and litter receptacles shall be furnished with disposable inner-linings, removable/reusable inner containers. Self-dumping type designs to include hinged bottom, top or sides will be rejected.

c. Anchors: Trash and litter receptacles that can be anchored to resist overturning by typical use, high winds, or animals shall be furnished and anchored in accordance with the manufacturer's recommendations.

d. Openings: Openings for trash and litter insertion shall be a minimum of 4 inches in diameter. Edges of the openings shall be crimped, rounded and smoothed.

e. Ash Receptacles: The Contractor shall provide ash receptacles with a fire-proof metal bowl or screen or sand-filled containers for ash containment. Ash receptacles shall have a minimum diameter of 8 inches; ash containers shall have a fire-proof metal bowl or screen and shall be easily removable for cleaning.

f. Planter Size: The planter size shall be determined according to the spacial root requirements at 2/3 maturity size of the designated plant material.

g. Drainage: Drainage for the planter shall be as follows: a minimum of one drainage hole in the base of each planter and a minimum 1/8 inch space, in 2 locations, between the base of the planter and the supporting surface.

h. Base: The planter base shall be capable of supporting the weight of the planter filled with both the designated plant material and fully saturated soil. The planter shall not crack, overturn, or sink below the existing grade. Planters shall allow for relocation.

2.8.1 Glass Fiber Reinforced Concrete (GFRC) Precast

Provide glass fiber reinforced concrete (GFRC) precast planters, waste receptacles, ash receptacles at locations indicated on the drawings. Comply with PCI MNL-117 and PCI MNL-128.

2.8.1.1 Materials

Provide manufacturer's standard shell thickness of 3/8 to 5/8 inch.

a. Cement: ASTM C 150, use only one brand and type of cement throughout the Project.

b. Glass Fibers: Alkali resistant (AR) glass fibers produced specifically for use in glass fiber reinforced concrete. Glass content of GFRC unit to be a minimum of three percent.

c. Aggregates: Clear silica sand passing No. 16 sieve; washed, dried, and free from deleterious materials; provide type with successful history of use in GFRC and as standard with the manufacturer.

d. Compressive Strength: Minimum 3000 psi 28 day strength.

e. Density: Approximately 120 pcf.

f. Polymer Admixture: Manufacturer's standard acrylic thermoplastic copolymer.

2.8.1.2 Finishes

Provide factory finished units with manufacturer's standard texture or sandblasted finish as selected.

a. Cement: White or grey as consistent with final finish.

b. Facing Aggregates: ASTM C 33 (less gradation), clean, hard, durable, inert, and free of staining and deleterious materials; as required to match approved samples.

c. Color: ASTM C 979, pure, non-fading mineral oxides which do not impair strength of GFRC; designed and mixed to provide color matching approved samples; maximum 10 percent cement weight.

d. Applied Finishes: ASTM D 4060 waterborne crosslinked acrylic 49.5

+/-2 percent solids by weight providing 1000 cycles per 0.001 inch resistance to abrasion.

2.8.2 Precast Concrete/Cast Stone Planters

Provide reinforced precast concrete planters waste receptacles, ash receptacles consisting of a mixture of cement, aggregates, and mineral colors suitable for exterior use as located on the drawings. Provide manufacturer's standard exposed aggregate or sandblast finish (with clear acrylic coating) as selected.

a. Portland Cement: ASTM C 150, gray, Type I.

b. Aggregate: ASTM C 33, No. 8 crushed limestone and sand.

c. Galvanized Steel Mesh: ASTM A 185/A 185M.

d. Integral Color: ASTM C 979, pure mineral oxide, limeproof and non-fading.

e. Concrete Strength: 4000 psi minimum compressive strength at 28 days.

f. Admixture: ASTM C 260 for air-entraining.

2.8.3 Fiberglass Planters Waste Receptacles Ash Receptacles

Provide reinforced fiberglass planters waste receptacles, ash receptacles molded with multiple laminations of glass fiber impregnated with polyester isophthalic thermosetting resins; with 12-15 mil color impregnated polyester gel coat finish; minimum thickness of 1/4 inch; color as selected.

2.8.4 Metal Planters Waste Receptacle

Provide metal planters waste receptacles as indicated, fabricated from perforated steel sheet material wire or diamond mesh steel sheet cast aluminum; powder coat finish, color as selected.

a. Metal thickness, width, and configuration shall be manufacturer's standard. Chemically clean and phosphate coat prior to final powdercoat.

b. Provide 3/16 inch thick fiberglass-reinforced polyester resin liner in black for planter liners.

2.9 SHELTERS

AISC 360. Provide prefabricated shelter systems to meet design conditions indicated. Shelter design shall conform to all applicable State and Local Building Codes and shall meet manufacturer's standards of construction and materials. Shelter systems shall be preglazed, pre-drilled and pre-cut, shipped with all hardware and accessories necessary for complete field assembly.

2.9.1 Framing Systems

Framing system; columns, rafters, ridge, purlins and other structural framing members shall be aluminum, steel, wood as indicated. Manufacturer shall provide shop drawings and calculations prepared by a structural

engineer.

a. Extruded aluminum alloy tubing shall conform to ASTM B 429/B 429M 6063-T5 or 3003-H14, dark medium, light bronze black, clear anodized, powder coat finish. Framing sizes and configurations shall be as required for size of structure indicated meeting manufacturer's standards and applicable building codes.

b. Structural steel shall conform to ASTM A 36/A 36M or ASTM A 500/A 500M, 36,000 psi yield strength and 58,000 psi tensile strength, factory finished with rust inhibited primer and powder coat conforming to ASTM D 3451. Framing sizes and configurations shall be as required for size of structure indicated meeting manufacturer's standard and applicable building codes.

2.10 TABLES

Picnic tables shall be furnished with attached benches that have no backrests. Table's exposed edges and corners shall be rounded, eased or chamfered.

a. Height: The table height shall be between 29-48 inches from the finished grade to the lowest surface of the top, or as noted.

b. Clearance: A minimum vertical clearance of 9 inches between the seat top and the bottom edge of the table top shall be provided. A minimum of 18 inches of leg space under tables, measured from the inside edge of the seat top to the nearest table support, shall be provided. A minimum of 18 inches from the end of the table top to the nearest support leg shall be provided.

c. Top: Table top surfaces shall not contain recesses that might hold water or food particles. The table top width shall be a minimum of 18 inches when utilized from one side only, and a minimum of 36 inches when utilized from two sides. The table top length shall be a minimum of 24 inches per person.

d. Wheelchair Access: A minimum clear space of 29 inches from the finished grade to the underside of the table shall be provided for persons with disability to be able to pull a wheelchair beneath the table top at the end of the table; the minimum clear width shall be 34 inches.

2.10.1 Precast Concrete Tables

Provide reinforced precast concrete tables with smooth tops; minimum 4500 psi concrete, 28 day minimum compressive strength, consisting of a mixture of cement, aggregates, and mineral colors suitable for exterior use as located on the drawings. Provide manufacturer's standard exposed aggregate or sandblast finish with clear acrylic coating.

a. Portland cement: ASTM C 150, gray, Type I.

b. Aggregate: ASTM C 33, washed No. 8 limestone and sand.

c. Galvanized wire mesh: 14 gage, 2 by 2 inch.

d. Welded wire fabric: ASTM A 185/A 185M

e. Reinforcing steel: ASTM A 615/A 615M

f. Integral color: ASTM C 979, pure mineral oxide, limeproof and non-fading

g. Admixture: ASTM C 260 for air-entraining.

2.10.2 Fiberglass Tables

Provide reinforced fiberglass table tops molded with multiple laminations of glass fiber impregnated with polyester isophthalic thermosetting resins, minimum thickness of 1/4 inch with 12-15 mil thickness color impregnated polyester gel coat, color as selected.

a. Steel pedestal base: ASTM A 53/A 53M Schedule 40 steel pipe, 2-3/8 inch O.D.

b. Mounting: Type as indicated.

c. Metal finish: Powder coating conforming to ASTM D 3451 testing.

2.10.3 Perforated Steel Tables

Provide 16 gage perforated steel sheet table tops with solid metal edges as per manufacturer's standard. Weld tops to base as required for frame support.

a. Steel pedestal base: ASTM A 53/A 53M Schedule 40 steel pipe, 2-3/8 inch O.D.

b. Mounting: Type as indicated.

c. Hardware: Zinc or cadium plated nuts, bolts, screws, and lock washers.

d. Metal finish: Powder coating conforming to ASTM D 3451 testing.

2.11 TREE GRATES

Provide cast aluminum, cast iron, cast bronze, punched steel, stainless steel tree grates in round or square model of sizes indicated on the drawings. Furnish complete with angle steel frames with finish to match tree grates.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings shall be installed plumb and true, at locations indicated,in accordance with the approved manufacturer's instructions.

3.1.1 Assembly and Erection of Components

Items shall be shipped knocked-down (KD) ready for site assembly. Packaged components shall be complete including all accessories and hardware. New

parts shall be acquired from the manufacturer; substitute parts will not be accepted unless approved by the manufacturer. When the inspection of parts has been completed, the site furnishings shall be assembled and anchored according to manufacturer's instructions or as indicated. When site furnishings are assembled at the site, assembly shall not interfere with other operations or pedestrian and vehicular circulation.

3.1.2 Anchorage, Fastenings, and Connections

Furnish metal work, mounting bolts or hardware in ample time for securing into concrete or masonry as the work progresses. Provide anchorage where necessary for fastening furniture or furnishings securely in place. Provide, for anchorage not otherwise specified or indicated, slotted inserts, expansion shields, and power-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish the fastenings to which they are applied. Conceal fastenings where practicable.

3.2 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.3 TESTING

Each site furnishing shall be tested to determine a secure and correct installation. A correct installation shall be according to the manufacturer's recommendations and by the following procedure: The Contractor shall measure the physical dimensions and clearance of each installed site furnishing for compliance with manufacturer's recommendations and as indicated. Site furnishings which do not comply shall be reinstalled. Fasteners and anchors determined to be non-compliant shall be replaced. A written report describing the results of the testing shall be provided.

3.4 FINISHES

3.4.1 Field Finishes

Where indicated, field finishes shall be applied in accordance with Section 09 90 00 PAINTS AND COATINGS. Where dissimilar metals are in contact, protect surfaces with a coat conforming to SSPC Paint 25 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.4.2 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Contracting Officer. Clean areas to be repaired and remove the slag from the welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and

wipe the excess material off.

3.5 CHILDREN'S PLAY AREAS

The site furnishings shall be installed outside the play structure use zone in accordance with ASTM F 1487. The Contractor shall verify and mark the locations of the use zone. These zones are to be free from obstacles and hard surfaces. When child accessibility requirements are to be met, child anthropometric dimensions must be used and not adult anthropometric dimensions.

3.6 BOLLARDS

Install in pipe sleeves embedded in concrete and filled with non-shrink grout or quick setting anchoring cement.

3.7 BICYCLE RACKS

Affix to base structure by flanges anchored to concrete or other existing masonry by expansion shields. Provide Series 300 stainless steel bolts to anchor aluminum alloy flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or concrete, give the contact surface a heavy coating of bituminous paint.

3.8 SHELTERS

Secure to the adjacent construction with the clip angles attached to the concrete. Secure to concrete with not less than two 1/2 inch diameter expansion bolts.

3.8.1 Glazing

Factory install windows into separate structural frame. Miter corners and connect internally by extruded aluminum corner keys or screw bosses with tamper-proof stainless steel screws. Provide continuous gasketing around windows set to metal frames. Provide 1/2 to 3/4 inch deep pocket for polycarbonate glazing. Fully gasket and frame in independent interchangable factory assembled units. Affix to shelter frame with 3/16 inch shallow head aluminum rivets at approximately13-1/4 inches on centers for full 360 degrees, rivet from inside of shelter.

3.8.2 Roof

Provide manufacturer's standard roof system including facia, gutter assembly, ensuring a weather-tight seal and installation.

3.9 RESTORATION AND CLEAN UP

When the installation has been completed, the Contractor shall clean up and protect the site. Existing areas that have been damaged from the installation operation shall be restored to original condition at Contractor's expense.

3.9.1 Clean Up

The site shall be cleaned of all materials associated with the installation. Site furnishing surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation.

Cleaning methods and agents shall be according to manufacturer's instructions or as indicated.

3.9.2 Protection

The area shall be protected as required or directed by providing barricades and signage. Signage shall be in accordance with Section 10 14 01 EXTERIOR SIGNAGE.

3.9.3 Disposal of Materials

Excess and waste material shall be removed and disposed off Government property.

3.10 RE-INSTALLATION

Where re-installation is required, the following shall be accomplished:

a. Re-install the product as specified. Material acquisition of replacement parts is the responsibility of the Contractor. Provide replacement materials that are new and supplied by the original manufacturer to match.

b. Damage caused by the failed installation shall be repaired.

-- End of Section --

SECTION 21 13 13.00 20

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(2005) Approval Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2006; Errata 2007) Installation of Sprinkler Systems
NFPA 13R	(2006) Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height
NFPA 1963	(2003) Standard for Fire Hose Connections
NFPA 24	(2006) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

UNDERWRITERS LABORATORIES (UL)

UL 262	(2004) Standard for Gate Valves for Fire-Protection Service
UL 668	(2004) Hose Valves for Fire Protection Service
UL 789	(2004) Indicator Posts for Fire-Protection Service
UL Fire Prot Dir	(2007) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

Design and provide new and modify existing automatic wet pipe fire extinguishing sprinkler systems for complete fire protection coverage throughout the entire building.

1.3 SPRINKLER SYSTEM DESIGN

Except as modified herein,design automatic wet pipe fire extinguishing sprinkler systems in accordance with the required and advisory provisions of NFPA 13, NFPA 13R, including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standard(s), as though the word "shall" had been substituted for the word "should" wherever it appears. Design system by hydraulic calculations for uniform distribution of water over the design area. Hydraulic calculations shall assume a 12 psi pressure loss for the backflow preventer assembly. Hydraulic calculations shall assume the pressure loss for the backflow preventer assembly is the same as the losses indicated on the manufacturer's data sheets. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Provide sprinklers and piping system layout. All Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM P7825 approved for use in wet pipe sprinkler systems. Provide seismic protection for the sprinkler system. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes."

1.3.1 Location of Sprinklers

Sprinklers in relation to the ceiling and the spacing of sprinklers shall not exceed that permitted by NFPA 13 for ordinary, extra hazard occupancy, sq ft per sprinkler, the hazards indicated on the contract drawings. Uniformly space sprinklers on the branch piping. Sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces.

1.3.2 Water Distribution

Distribution shall be uniform throughout the area in which the sprinklers will open. Discharge from individual sprinklers in hydraulically most remote area shall be between 100 percent and 120 percent of the specified density.

1.3.3 Density of Application of Water

Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be ____ gpm per sq ft., as indicated on Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be 0.10 gpm per sq ft for Light Hazard Occupancies, 0.15 gpm per sq ft for Ordinary Hazard Group 1 Occupancies, 0.20 gpm per sq ft for Ordinary Hazard Group 2 Occupancies, 0.30 gpm per sq ft for Extra Hazard Group 1 Occupancies, 0.40 gpm per sq ft for Extra Hazard Group 2 Occupancies ___ gpm per sq ft, as indicated on the contract drawings.

1.3.4 Sprinkler Discharge Area

Permissible decreases and required increases from NFPA 13 shall be applied to an initial hydraulically most remote area of ____ sq ft.

Area shall be the hydraulically most remote ____ sq ft Area reductions and increases from NFPA 13 shall not be applied to this area.

1.3.5 Outside Hose Allowances

Hydraulic calculations shall include a hose allowance of ____ gpm for outside hose streams

1.3.6 Water Supply

Base hydraulic calculations on the water supply data shown on the fire protection contract drawings, the water supply data shown on the contract drawings, a static pressure of ____ psig with ____ gpm available at a residual pressure of ____ psig, at the junction with the existing water distribution piping system, base of the sprinkler piping riser. Base hydraulic calculations on operation of fire pumps provided in Section 21 30 00 FIRE PUMPS.

1.4 SUBMITTALS

Partial submittals and submittals not fully complying with the requirements and recommended practices of NFPA 13 and this specification section shall be returned disapproved without review. This contract stipulation is non-negotiable.

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings

Prepare 24 by 36 inch detail working drawings of sprinklers and piping. Floor plans shall be drawn to a scale not less than 1/8" = 1'-0". Show data essential for proper installation of each system. Show details, plan view, elevations and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe and fittings. Show point to point electrical wiring diagrams. Submit drawings signed by a registered fire protection engineer. Provide three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation.

SD-03 Product Data

Pipe
Fittings
Alarm valves
Valves, including gate, check, and globe
Water motor alarms
Sprinklers
Pipe hangars and supports
Sprinkler Alarm Switches
Fire department connections
Excess pressure pump
Mechanical couplings
Backflow Prevention Assembly
Seismic Bracing

Annotate descriptive data to show the specific model, type, and size of each item. Catalog cuts shall also indicate UL Listing/FM Approval and country of manufacture.

SD-05 Design Data

Hydraulic Calculations

Submit computer program generated hydraulic calculations to substantiate compliance with hydraulic design requirements. Calculations shall be performed by computer using software intended specifically for fire protection system design. Calculations shall include isometric diagram indicating hydraulic nodes and pipe segments.Submit name of software program used.

SD-06 Test Reports

request to schedule Preliminary Tests

Preliminary Test Report

Three copies of the completed Preliminary Test Report, no later that 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Engineer.

request to schedule Final Acceptance Test

Final Acceptance Test Report

Three copies of the completed Final Acceptance Tests Reports, no later that 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Engineer.

SD-07 Certificates

Inspection by Fire Protection Engineer

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Engineer that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

Fire Protection Engineer

The name and documentation of certification of the proposed Fire Protection Engineer, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer

Submit data showing the Sprinkler System Installer has successfully installed systems of the same type and design as

specified herein, Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months. Provide NICET certification of the system technician. Contractor shall submit data along with submittal of the Fire Protection Engineer Qualifications.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modifies by this specification section.

Provide six manuals in accordance with NFPA 13. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

SD-11 Closeout Submittals

As-built drawings

As-built shop drawings, at no later than 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed. Provide electronic drawings in dwg or pdf format.

On-site training

1.5 QUALIFICATIONS

1.5.1 Fire Protection Engineer

A Fire Protection Engineer is a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES) or a registered P.E. in a related engineering discipline with a minimum of 5 years experience, dedicated to fire protection engineering that can be verified with documentation.

1.5.2 Sprinkler System Installer

The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Installation drawings, shop drawings and as-built drawings shall be prepared, by or under the supervision of, an system technician who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering

Technologies (NICET) as an engineering technician with minimum Level III, Level IV certification in Automatic Sprinkler System program or by a fire protection engineer.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.6.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.6.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.4 Field Fabricated Nameplates

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

1.8 DELIVERY, STORAGE AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

PART 2 PRODUCTS

2.1 UNDERGROUND PIPING COMPONENTS

2.1.1 Pipe

Pipe shall comply with NFPA 24. Minimum pipe size shall be 6 inches. Piping more than 5 feet outside the building walls shall comply with Section 33 11 00 WATER DISTRIBUTION.

2.1.2 Gate Valve and Indicator Posts

Installation shall comply with NFPA 24. Gate valves for use with indicator post shall conform to UL 262. Indicator posts shall conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint.

2.1.3 Valve Boxes

Except where indicator posts are provided, for each buried valve, provide cast-iron, ductile-iron, or plastic valve box of a suitable size. Plastic boxes shall be constructed of acrylonitrile-butadiene-styrene (ABS) or inorganic fiber-reinforced black polyolefin. Provide cast-iron, ductile-iron, or plastic cover for valve box with the word "WATER" cast on the cover. The minimum box shaft diameter shall be 5.25 inches. Coat cast-iron and ductile-iron boxes with bituminous paint applied to a minimum dry-film thickness of 10 mils.

2.1.4 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold block letters continuously and repeatedly over the entire tape length. Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.2 ABOVEGROUND PIPING COMPONENTS

All components of the aboveground piping shall fully comply with the requirements and recommended practices of NFPA 13 and this specification section. Aboveground piping shall be steel or copper, copper, or plastic

2.2.1 Steel Pipe

Pipe shall be rigid black steel, galvanized steel. Steel piping shall be Schedule 10 or 40 for sizes less than 8 inches and Schedule 10, 30, 40 for sizes 8 inches or larger. Steel pipe shall be Schedule 40 for sizes less than 3 inches and Schedule 10, 30, 40 for sizes 3 inches or larger. Fittings into which sprinklers, sprinkler riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved-end type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 1.5 inches and larger. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the

same manufacturer. Steel piping with wall thickness less than Schedule 30 shall not be threaded. Side outlet tees using rubber gasketed fittings shall not be permitted. Sprinkler pipe and fittings shall be metal. Roll grooving of galvanized pipe is prohibited

2.2.2 Grooved Mechanical Joints and Fittings

Grooved couplings, fittings and grooving tools shall be products of the same manufacturer.

2.2.3 Flexible Sprinkler Hose

The use of flexible sprinkler hose is permissible.

2.2.4 Plastic Pipe and Fittings

Plastic pipe shall be Chlorinated polyvinyl chloride (CPVC)

2.2.5 Sprinklers

Provide nominal 0.50 inch or 0.53 inch orifice sprinklers. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Provide Concealed, Recessed, Flush, Pendent, Upright, Sidewall, Residential, quick response, sprinklers. Sprinklers shall have a brass, polished chrome, stainless steel, white polyester finish. Temperature classification shall be ordinary, intermediate, as indicated. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used. Provide corrosion-resistant sprinklers and sprinkler guards as required by NFPA 13. Deflector shall not be more than 3 inches below suspended ceilings. Ceiling plates shall not be more than 0.5 inch deep. Ceiling cups shall not be permitted.

2.2.6 Valves

Provide valves of types approved for fire service. Valves shall open by counterclockwise rotation. Provide a rising stem. an OS&Y, a butterfly, a wall indicator valve beneath each alarm. Check valves shall be clear opening swing-check type with inspection and access cover plate for sizes 8 inches and larger. Each control valve shall be electrically supervised; minimum contact ratings shall be 2.5 amps at 24 volts DC. Provide supervision against valve closure or tampering of valve.

2.2.7 Pipe Supports

Provide Pipe hangars and supports and Seismic Bracing in accordance with NFPA 13.

2.2.8 Alarm Valves

Provide variable pressure type alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.2.9 Water Motor Alarms

Provide alarms of the approved weatherproof and guarded type, to sound locally on the flow of water in each corresponding sprinkler system. Mount

alarms on the outside of the outer walls of each building at a location as directed. Provide separate drain piping directly to exterior of building.

2.2.10 Fire Department Connections

Fire department connection shall be projecting, flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass, chromium plated finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

2.2.11 Backflow Prevention Assembly

Provide listed reduced pressure principle, double check, valve assembly backflow preventer. Each check valve shall have a drain. Backflow prevention assemblies shall have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List. Listing of the specific make, model, design, and size in the FCCCHR List shall be acceptable as the required documentation."

2.2.12 Excess Pressure Pump

Provide pumps on each sprinkler piping riser. Pumps shall be of the positive displacement, gear type rated at one gpm, integrally mounted with motor. Pump and motor unit shall be approved for automatic wet pipe fire extinguishing sprinkler systems and shall be complete with pilot light panel, differential motor control switch, high pressure switch, and low pressure switch. Provide electrical power supply connections for pump and pilot light panel at the supply side of building service panel; provide a separate fused safety-type switch with locked lever for each connection. Provide pressure pump sensing piping in supply piping upstream of fire pump.

2.3 ALARM INITIATING AND SUPERVISORY DEVICES

2.3.1 Sprinkler Alarm Switches

Provide pressure and or vane type flow switch(es) with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system. Connection of switch shall be under Section 28 31 73.00 20 EXTERIOR FIRE ALARM SYSTEM, 28 31 74.00 20 INTERIOR FIRE ALARM SYSTEM, 28 31 63.00 20 ANALOG/ADDRESSABLE INTERIOR FIRE ALARM SYSTEM, 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, Vane type Alarm actuating devices shall have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and shall instantly recycle. Flow switches for elevator power shunt shall have no retard feature. Provide properly lettered and approved metal sign to elevator flow switch stating the circuits' voltage, and identify the switch as an "Elevator Power Shunt Flow Switch".

2.3.2 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.4 ACCESSORIES

2.4.1 Sprinkler Cabinet

Provide metal cabinet with extra sprinklers, including a representative sample of dry pendent type sprinklers and sprinkler wrench adjacent to each alarm valve. The number and types of extra sprinklers shall be as specified in NFPA 13.

2.4.2 Pipe Escutcheon

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

PART 3 EXECUTION

3.1 INSPECTION BY FIRE PROTECTION ENGINEER

The Fire Protection Engineer shall inspect the sprinkler system periodically during the installation to assure the sprinkler system is being provided and installed in accordance with the contract requirements and the approved sprinkler system submittal(s). The Fire Protection Engineer shall attend both the preliminary and final tests, and shall sign the test results. After the preliminary testing has been completed, the Fire Protection Engineer, shall certify in writing the system is ready for the final inspections and tests. This report shall document any discrepancies found and what actions will be taken to correct. Any discrepancy noted during the periodic site visits or the preliminary testing shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.2 UNDERGROUND PIPING INSTALLATION

The methods of fabrication and installation of the underground piping shall fully comply with the requirements and recommended practices of NFPA 13, NFPA 24 and the contract drawings.

3.3 ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the aboveground piping shall fully comply with the requirements and recommended practices of NFPA 13 and this specification section.

3.3.1 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.3.2 Pendent Sprinklers

Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of

the ceiling. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grids.

3.3.3 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. The diameter of grooves made in the field shall be measured using the method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. A representative of the grooved couplings and fittings manufacturer shall conduct at least one onsite inspection of the piping installation to ensure the method of installation is in accordance with the manufacturer's requirements and recommended practices.

3.3.4 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. Bushings are prohibited.

3.3.5 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.3.6 Inspector's Test Connection

Provide test connections approximately 6 feet above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device. Provide test connection piping to a drain location that can accept full flow where the discharge will be readily visible and where water may be discharged without property damage. Discharge to floor drains, janitor sinks or similar fixtures shall not be permitted. Provide discharge orifice of same size as corresponding sprinkler orifice. The penetration of the exterior wall shall be no greater than 2 feet above finished grade.

3.3.7 Backflow Preventer Test Connection

Provide downstream of the backflow prevention assembly UL 668 hose valves

with 2.5 inch National Standard male hose threads with cap and chain. Provide one valve for each 250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads, "Test Valve."

3.3.8 Drains

Main drain piping shall be provided to discharge at a safe point outside the building, at the location indicated. Auxiliary drains shall be provided as required by NFPA 13.

3.3.9 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade, adjacent to and on the sprinkler system side of the backflow preventer. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.3.10 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Valve identification signs shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.4 ELECTRICAL WORK

Except as supplemented and modified herein, electric equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP and Section 28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. 28 31 63.00 20 ANALOG/ADDRESSABLE INTERIOR FIRE ALARM SYSTEM, 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM

3.5 PIPE PAINTING AND COLOR CODE MARKING

Paint and color code mark sprinkler piping system as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Submit request to schedule Preliminary Tests, no later than 14 days prior to the proposed start of the tests. Upon completion of specified tests, the Contractor shall submit for approval a Preliminary Test Report.

3.6.1 Underground Piping

3.6.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24.

3.6.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24.

3.6.2 Aboveground Piping

3.6.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13.

3.6.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5 inch diameter hoses, playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. A metal placard shall be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate determined during the preliminary testing. The pressure drop shall be compared to the manufacturer's data and the readings observed during the final inspections and tests.

3.7 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. Submit request to schedule Final Acceptance Test, no later than 14 days prior to the proposed start of the tests. Notification shall include a copy of the Contractor's Material & Test Certificates.

The Fire Protection Engineer shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. The Contractor shall submit the Final Acceptance Test Report as specified in the Submittals paragraph.

An experienced technician regularly employed by the system installer shall be present during the inspection. The Fire Protection Engineer shall attend the final inspections and tests. At this inspection, repeat any or all of the required tests as directed. Correct defects in work provided by

the Contractor, and make additional tests until the systems comply with contract requirements. Furnish appliances, equipment, water, electricity, instruments, connecting devices, and personnel for the tests. The Government will furnish water for the tests. The Naval Facilities Engineering Command, Fire Protection Engineer, will witness formal tests and approve systems before they are accepted.

3.8 ON-SITE TRAINING

Submit request to schedule the On-site Training, at least 14 days prior to the start of related training but prior to the final inspections and tests. The sprinkler contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 8 hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

<END/>

SECTION 21 13 16.00 20

DRY-PIPE FIRE SPRINKLER SYSTEMS

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains

ASME INTERNATIONAL (ASME)

ASME A17.1	(2007) Safety Code for Elevators and Escalators

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(2005) Approval Guide

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List	(continuously updated) List of Approved Backflow Prevention Assemblies

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2006; Errata 2007) Installation of Sprinkler Systems
NFPA 24	(2006) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 70	(2007) National Electrical Code - 2008 Edition

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; E 2004) Paint Specification No. 25Zinc Oxide, Alkyd, Linseed Oil Primer

	for Use Over Hand Cleaned Steel Type I and Type II

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-2962	(Rev J) Enamel, Alkyd, Gloss, Low VOC Content

UNDERWRITERS LABORATORIES (UL)

UL 262	(2004) Standard for Gate Valves for Fire-Protection Service
UL 789	(2004) Indicator Posts for Fire-Protection Service
UL Fire Prot Dir	(2007) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

Design and provide new and modify existing automatic dry pipe fire extinguishing sprinkler systems for complete fire protection coverage.

1.3 SPRINKLER SYSTEM DESIGN

Design automatic dry pipe fire extinguishing sprinkler systems in accordance with the required and advisory provisions of NFPA 13, by pipe schedules or hydraulic calculations using the area/density method for uniform distribution of water over the design area for ordinary, extra hazard occupancy. Each system shall include materials, accessories, and equipment inside and outside the building to provide each system complete and ready for use. Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed working drawings to be submitted for approval. Locate sprinkler heads in a consistent pattern with ceiling grid, lights, and air supply diffusers. Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM P7825 approved for use in dry pipe sprinkler systems. Design systems for earthquake protection.

1.3.1 Location of Sprinkler Heads

Spacing of sprinklers and position and orientation of sprinklers in relation to the ceiling, walls, and obstructions shall conform to NFPA 13 for ordinary hazard occupancy; except for discharge density greater than 0.20 gpm per sq ft the spacing of sprinkler heads shall not exceed that for extra hazard occupancy. Uniformly space sprinklers on the branch piping.

1.3.2 Water Distribution

Distribution shall be uniform throughout the area in which the sprinkler heads will open. Discharge from individual sprinklers in the hydraulically most remote area shall be not less than 100 percent of the specified density.

1.3.3 Density of Application of Water

Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal

surfaces below the sprinklers shall be as indicated.

1.3.4 Sprinkler Design Area

Area shall be the hydraulically most remote as indicated and as defined in NFPA 13.

1.3.5 Outside Hose Allowances

Hydraulic calculations shall include an allowance as indicated for outside hose streams.

1.3.6 Friction Losses

Calculate losses in piping in accordance with the Hazen-Williams formula with 'C' value of 100 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping. Velocity in the sprinkler piping shall be limited to a maximum of 20 ft/sec.

1.3.7 Water Supply

Base hydraulic calculations on a static pressure of _____ psig with ____ gpm available at a residual pressure of _____ psig at the junction with the water distribution piping system, base of the sprinkler piping riser. Include discharge from fire pump(s) provided in Section 21 30 00 FIRE PUMPS in the hydraulic calculations. Provide 5 psi cushion between total calculated demand and the water supply.

1.3.8 Detail Drawing

Prepare 24 by 36 inch detail working drawings of sprinkler heads and piping system layout in accordance with NFPA 13, "Working Drawings (Plans)." Show data essential for proper installation of each system. Show details, plan view, elevations, and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams. Show location and orientation of sprinkler heads in relation to obstructions. Submit drawings signed by a registered fire protection engineer.

1.3.9 Detail Drawings

After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes. Submit 24 by 36 inch drawings on reproducible mylar film with title block similar to full size contract drawings. Furnish the as-built (record) working drawings in addition to as-built contract drawings required by Division 1, "General Requirements."

1.4 SUBMITTALS

The Naval Facilities Engineering Command, Fire Protection Engineer, will review and approve all submittals in this section requiring Government approval.

The Naval Facilities Engineering Command, Fire Protection Engineer delegates the authority to the Quality Control (QC) Representative's U.S. Registered Fire Protection Engineer for review and approval of submittals required by this section. Submit to the Naval Facilities Engineering Command, Fire Protection Engineer one set of all approved submittals and

drawings immediately after approval but no more later than 15 working days prior to final inspection.

SD-02 Shop Drawings

Sprinkler heads and piping system layout

Electrical wiring diagrams

SD-03 Product Data

Piping

Valves, including gate, check, and globe

Water motor alarms

Sprinkler heads

Pipe hangers and supports

Fire department connections

Low air pressure supervisory switch

Dry pipe valves

Air compressor

Mechanical couplings

Backflow Preventers

Pressure Switch

Annotate descriptive data to show the specific model, type, and size of each item.

SD-05 Design Data

Sprinkler system design

Submit computer program generated hydraulic calculations to substantiate compliance with hydraulic design requirements. Calculations generated by computer program shall include the name, address, and telephone number of the software manufacturer.

SD-06 Test Reports

Preliminary tests on piping system

SD-07 Certificates

Qualifications of installer

SD-10 Operation and Maintenance Data

Dry pipe valves, Data Package 3

Air compressor, Data Package 3

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

As-built drawings of each system

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Installer

Prior to installation, submit data showing that the Contractor has successfully installed systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.

Qualifications of System Technician: Installation drawings, shop drawing and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in automatic sprinkler system program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

PART 2 PRODUCTS

2.1 ABOVEGROUND PIPING SYSTEMS

Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Perform welding in the shop; field welding will not be permitted. Conceal piping in areas with suspended ceiling and as indicated.

2.1.1 Sprinkler Piping

NFPA 13, except as modified herein. Steel piping shall be Schedule 10 or 40 for sizes less than 8 inches, and may be Schedule 10, 30, or 40 for sizes 8 inches and larger. Fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved-end type. Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 1.5 inches and larger. Fittings shall be UL Fire Prot Dir listed or FM P7825 approved for use in dry pipe sprinkler systems. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer. Steel piping with wall thickness less than Schedule 30 shall not be threaded. Steel piping shall be galvanized. Sprinkler pipe and fittings shall be metal.

2.1.2 Sprinkler Heads

Provide nominal 0.50 inch or 0.53 inch orifice standard, quick response sprinkler heads. No o-rings will be permitted in sprinkler heads. Release element of each head shall be of the ordinary, intermediate temperature rating or higher as suitable for the specific application. Provide polished stainless steel ceiling plates or chromium-plated finish on copper alloy ceiling plates, and chromium-plated pendent sprinklers below suspended ceilings. Provide corrosion-resistant sprinkler heads and sprinkler head guards as required by NFPA 13. Automatic sprinklers installed in the pendent position shall be of the dry-pendent type except that standard pendent sprinklers may be installed on return bends when both the sprinklers and the return bends are located in a heated area.

2.1.3 Cabinet

Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each dry pipe valve. The number and types of extra sprinkler heads shall be as specified in NFPA 13.

2.1.4 Dry Pipe Valves

Provide valve complete with accessories and appurtenances for the proper operation of the system.

2.1.5 Water Motor Alarms

Provide alarms of the approved weatherproof and guarded type, to sound locally on the flow of water in each corresponding sprinkler system. Mount alarms on the outside of the outer walls of each building at a location as directed. Provide separate drain piping directly to exterior of building.

2.1.6 Pressure Switch

Provide switch with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system. Connection of switch shall be under Section 28 31 73.00 20 EXTERIOR FIRE ALARM SYSTEM, 28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM. Do not install a shutoff valve in the piping between the dry pipe valve and any pressure switch.

2.1.7 Low Air Pressure Supervisory Switch

Provide switch for each sprinkler system and connect to building fire alarm system to activate the system supervisory alarm when air pressure in system drops halfway from the normal pressure to the tripping point. Connection of switch shall be under Section 28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM. Provide a bleeder valve in the air line ahead of the switch for testing operation of the switch. The valve shall be normally open. Closing the valve shall shut off the air supply to the switch and exhaust the pressure between the switch and valve.

2.1.8 Tank Mounted Air Compressor

Provide an approved, automatic type, electric motor-driven air compressor including pressure switch, air piping, and 10 gallon minimum capacity tank. Compressor shall have a minimum capacity capable of charging the complete sprinkler system to normal system air pressure within 30 minutes. Provide an approved automatic air maintenance device for each system.

2.1.9 Pipe Hangers and Supports

Provide in accordance with NFPA 13. Attach to steel joists with MSS SP-58, Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor.

2.1.10 Valves

NFPA 13. Provide valves of types approved for fire service. Valves shall open by counterclockwise rotation. Provide a rising stem, an OS&Y, a wall indicator valve beneath each dry pipe valve. Check valves shall be flanged, clear opening swing-check type valves with flanged inspection and access cover plate for sizes 4, 8 inches and larger. Provide OS&Y gate valve in piping to sprinklers protecting elevator hoistways, machine rooms, and machinery spaces in accordance with ASME A17.1.

2.1.10.1 Backflow Preventers

Provide double check valve assembly backflow preventer with OS&Y gate valve backflow preventer with OS&Y gate valve on both ends. Each check valve shall have a drain. Backflow prevention assemblies shall have current "Certificate of Approval" from the Foundation For Cross Connection Control and Hydraulic Research FCCCHR List. Listing of the specific make, model, design, and size in the FCCCHR List shall be acceptable as the required documentation. Provide downstream of the backflow prevention assembly listed hose valves with 2.5 inch National standard male hose threads with cap and chain. Provide one valve for each 250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads, "Test Valve."

2.1.10.2 Valve Supervision

Provide supervision of each control valve against closure and tampering in accordance with NFPA 13. Provide switch with SPDT (Form C) dry contacts for the automatic transmittal of a supervisory signal over the facility fire alarm system; minimum switch contact rating shall be 2.5 amperes at 24 VDC. A supervisory signal shall be initiated during the first two revolutions of the hand wheel, or during the first 1/5th of travel distance of the valve stem, from the full open position. Connection of the switch shall be under Section 28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM, 28 31 63.00 20 ANALOG / ADDRESSABLE INTERIOR FIRE ALARM SYSTEM. Provide breakaway key operated locks and steel chains to secure all control valves against unauthorized closure or tampering.

2.1.11 Identification Signs

NFPA 13. Attach properly lettered and approved metal signs to each valve and alarm device. Permanently affix hydraulic design information sign to the riser of each system. For pipe schedule systems, provide a hydraulic design information sign stating: This is a light, ordinary extra hazard pipe schedule system.

2.1.12 Inspector's Test Connection

Provide test connections approximately 6 feet above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device; locate at the hydraulically most remote part of each system. Provide test connection piping to a location where the discharge will be readily visible and where water may be discharged without property damage. Provide discharge orifice of same size as corresponding sprinkler orifice. Provide a precast concrete splash block under each exterior discharge orifice.

2.1.13 Main Drains

Provide separate drain piping to discharge at safe points outside each building, to sight cones attached to drains of adequate size to readily receive the full flow from each drain under maximum pressure. The penetration of the exterior wall shall be no greater than 2.0 feet, above finished grade. Provide auxiliary drains as required by NFPA 13. Provide precast concrete splash blocks under each exterior drain discharge.

2.1.14 Fire Department Connections

Provide 4 inches single Storz type connections approximately 3 feet above finish grade, of the approved two-way type with 2.5 inch National standard female hose threads with brass caps, chain, and identifying fire department connection escutcheon plate.

2.2 BURIED WATER PIPING SYSTEMS

2.2.1 Pipe and Fittings

Provide outside-coated, cement-mortar lined, ductile-iron pipe, and fittings conforming to NFPA 24 for piping under the building and outside of building walls. Anchor joints in accordance with NFPA 24. Provide concrete thrust block at the elbow where the pipe turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Minimum pipe size shall be 6 inches. Minimum depth of cover shall be 3 feet at finish grade. Piping beyond 5 feet outside of building walls shall be provided under Section 33 11 00 WATER DISTRIBUTION.

2.2.2 Valves

Provide as required by NFPA 24. Gate valves shall conform to UL 262 and shall open by counterclockwise rotation.

2.2.3 Post Indicator Valves

Provide with operating nut located about 3 feet above finish grade. Gate valves for use with indicator post shall conform to UL 262. Indicator posts shall conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint.

2.2.4 Valve Boxes

Except where indicator posts are provided, for each buried valve, provide cast-iron, ductile-iron, or plastic valve box of a suitable size. Plastic boxes shall be constructed of acrylonitrile butadiene styrene (ABS) or inorganic fiber-reinforced black polyolefin. Provide cast-iron,

ductile-iron, or plastic cover for valve box with the word "WATER" cast on the cover. The minimum box shaft diameter shall be 5.25 inches. Coat cast-iron and ductile-iron boxes with bituminous paint applied to a minimum dry-film thickness of 10 mils.

2.2.5 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.3 PIPE SLEEVES

Provide where piping passes entirely through walls, floors, and roofs. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs. Provide one inch minimum clearance between exterior of piping and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with UL listed fill, void, or cavity material.

a. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs: Provide 26 gage galvanized steel sheet.

2.4 ESCUTCHEON PLATES

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

PART 3 EXECUTION

3.1 INSTALLATION

Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 13, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings. Keep the interior and ends of new piping and existing piping affected by Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping

before placing into position. Provide Teflon pipe thread paste on male threads.

3.1.1 Electrical Work

Provide electrical work associated with this section under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring. Provide fire alarm system under Section 28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM. Provide control and fire alarm wiring, including connections to fire alarm systems, under this section in accordance with NFPA 70. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

3.1.2 Disinfection

Disinfect the new water piping and existing water piping affected by Contractor's operations up to the bottom flange of the dry pipe valve backflow prevention device in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million (ppm) of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 ppm, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit results prior to the new water piping being place into service. Disinfection of systems supplied by nonpotable water is not required.

3.1.3 Connections to Existing Water Supply Systems

Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around the main piping; bolt valve to the branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, all without interruption of service. Notify the Contracting Officer in writing at least 15 days prior to connection date; receive approval before any service is interrupted. Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labor as required. Furnish, Government will furnish only the labor and the tapping or drilling machine for making the actual connections to existing systems. All piping shall be photographed prior to burying, covering, or concealing.

3.1.4 Buried Piping System

Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.5 Field Painting

Painting of sprinkler systems above suspended ceilings and in crawl spaces is not required. Clean, prime, and paint new sprinkler system piping, valves, hangers, accessories, and miscellaneous metal work as specified in Section 09 90 00 PAINTS AND COATINGS and herein. Clean surfaces prior to painting. Immediately after cleaning, prime metal surfaces with SSPC Paint 25 or SSPC Paint 25 metal primer applied to a minimum dry film thickness of 1.5 mils. Exercise care to avoid painting sprinkler heads and

operating devices. Upon completion of painting, remove materials which were used to protect sprinkler heads and operating devices which have been inadvertantly painted and provide new clean sprinkler heads and operating devices of the proper type. Finish primed surfaces as follows:

3.1.5.1 Systems in Finished Areas

Finished areas are defined as areas where walls or ceilings are painted or are constructed of a prefinished material. Paint primed surfaces with two coats of paint to match adjacent surfaces, except paint valves and operating accessories with two coats of gloss red enamel. Provide piping with 2 inch wide red bands spaced at maximum 20 feet intervals throughout the piping system. Bands shall be gloss red enamel or self-adhering plastic.

3.1.5.2 Systems in Unfinished Areas

Paint piping in valve rooms, and mechanical rooms, and attics and crawl spaces with FS A-A-2962 gloss red enamel applied to a minimum dry film thickness of 1.6 mils.

3.2 FIELD QUALITY CONTROL

Perform test to determine compliance with the specified requirements in the presence of the Contracting Officer. Test, inspect, and approve piping before covering or concealing.

3.2.1 Preliminary Tests

Hydrostatically test each system at 50 psig above normal system static pressure or 200 psig, whichever is greater, for a 2-hour period with no leakage or reduction in pressure. Flush piping with potable water and air test each system in accordance with NFPA 13. Piping above suspended ceilings shall be tested, inspected, and approved before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. Water shall be delivered to the system test connection in not more than 60 seconds, starting at the normal air pressure on the system and at the time of a fully opened inspection test connection. When tests have been completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13.

3.2.2 Formal Tests and Inspections

Do not submit a request for formal test and inspection until the preliminary test and corrections are completed and approved. Submit a written request for formal inspection at least 15 days prior to inspection date. An experienced technician regularly employed by the system installer shall be present during the inspection. At this inspection, repeat any or all of the required tests as directed. Correct defects in work provided by the Contractor, and make additional tests until the systems comply with contract requirements. Furnish appliances, equipment, water, electricity, instruments, connecting devices, and personnel for the tests. The Government will furnish water for the tests. The Naval Facilities Engineering Command, Fire Protection Engineer, will witness formal tests and approve systems before they are accepted.

-- End of Section --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

12/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	(2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22	(1999; A 2001) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2004; Addendas a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,r,s,t,u,v,x,ak 2006; Supp to Addendas 2006; Errata 2007) Energy Standard for Buildings Except Low-Rise Residential Buildings, I-P Edition

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2002) Atmospheric Type Vacuum Breakers
ASSE 1003	(2001; Errata, 2003) Performance Requirements for Water Pressure Reducing Valves
ASSE 1005	(1999) Water Heater Drain Valves 3/4 Inch Size
ASSE 1010	(2004) Water Hammer Arresters
ASSE 1011	(2004; Errata 2004) Hose Connection Vacuum Breakers
ASSE 1012	(2002) Backflow Preventer with Intermediate Atmospheric Vent
ASSE 1013	(2005) Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
ASSE 1018	(2001) Trap Seal Primer Valves - Potable,

Water Supplied

ASSE 1020 (2004; Errata 2004; Errata 2004) Pressure Vacuum Breaker Assembly

ASSE 1037 (1990) Performance Requirements for Pressurized Flushing Devices (Flushometer) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084 (2005) Standard Methods for the Examination of Water and Wastewater

AWWA B300 (2004) Hypochlorites

AWWA B301 (2004) Liquid Chlorine

AWWA C203 (2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA C606 (2006) Grooved and Shouldered Joints

AWWA C651 (2005; Errata 2005) Standard for Disinfecting Water Mains

AWWA C652 (2002) Disinfection of Water-Storage Facilities

AWWA C700 (2002; R 2003) Standard for Cold Water Meters - Displacement Type, Bronze Main Case

AWWA C701 (2002) Standard for Cold-Water Meters - Turbine Type for Customer Service

AWWA D100 (2005) Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding

AWS B2.2 (1991) Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2 (2004) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)

ASME A112.14.1 (2003) Backwater Valves

ASME A112.19.1M (1994; R 2004) Enameled Cast Iron Plumbing Fixtures

ASME A112.19.2M (2003) Standard for Vitreous China

	Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.19.3	(2000: R 2004) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.19.4M	(1994; R 2004) Porcelain Enameled Formed Steel Plumbing Fixtures
ASME A112.19.5	(2005) Trim for Water-Closet Bowls, Tanks and Urinals
ASME A112.21.2M	(1983) Roof Drains
ASME A112.36.2M	(1991; R 2002) Cleanouts
ASME A112.6.1M	(1997; R 2002) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2001; R 2007) Standard for Floor and Trench Drains
ASME B1.20.1	(1983; R 2006) Pipe Threads, General Purpose (Inch)
ASME B16.12	(1998; R 2006) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 2004) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2002; Errata 2003; R 2006) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2001) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500
ASME B16.29	(2001) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	(1998; R 2006) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2004) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1998; R 2006) Standard for Malleable Iron

	Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.4	(2006) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B31.1	(2004; Addenda A 2005; Addenda B 2006) Power Piping
ASME B31.5	(2001; Addenda 2004) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2006) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2007) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2007) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME CSD-1	(2006) Control and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M	(2005) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 193/A 193M	(2007) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 515/A 515M	(2003) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2006) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518/A 518M	(1999; R 2003) Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A 53/A 53M	(2006a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 733	(2003) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

ASTM A 74	(2006) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A 888	(2007a) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 117	(2007) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 32	(2004) Standard Specification for Solder Metal
ASTM B 370	(2003) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B 42	(2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B 584	(2006a) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B 75	(2002) Standard Specification for Seamless Copper Tube
ASTM B 813	(2000e1) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 828	(2002) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2005) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C 564	(2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1004	(2007) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 2564	(2004) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2665	(2007) Standard Specification for

	Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2822	(2005) Asphalt Roof Cement
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a; R 2003e1) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3311	(2006a) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4551	(1996; R 2001) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM D 638	(2003) Standard Test Method for Tensile Properties of Plastics
ASTM E 1	(2005) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E 96	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM F 409	(2002) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 477	(2007) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 877	(2007) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold- Water Distribution Systems

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2004) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2004) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(1994; R 1995) Copper Tube Handbook

CSA AMERICA, INC. (CSA/AM)

CSA/AM Z21.10.1	(2004; E 2005; A 2006, 2006) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
CSA/AM Z21.10.3	(2004) Gas Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous
CSA/AM Z21.56	(2006) Gas-Fired Pool Heaters

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual	(1988e9) Manual of Cross-Connection Control

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO Z124.1.2	(2005) Plastic Bathtub and Shower Units
IAPMO Z124.8	(1990) Plastic Bathtub Liners

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2003; R 2004) Standard for Accessible and Usable Buildings and Facilities
ICC NCPC	(2006) North Carolina Plumbing Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ISEA Z358.1	(2004) Emergency Eyewash and Shower Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(2002a; R 2004) Standard for Butterfly Valves
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application

MSS SP-70 (2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (2005) Standard for Gray Iron Swing Check Valves, Flanged and Threaded Ends

MSS SP-72 (1999) Standard for Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-73 (2003) Brazing Joints for Copper and Copper Alloy Pressure Fittings

MSS SP-78 (2005a) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (2003) Bronze Gate, Globe, Angle and Check Valves

MSS SP-83 (2006) Standard for Class 3000 Steel Pipe Unions Socket Welding and Threaded

MSS SP-85 (2002) Standard for Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2003) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31 (2006; Errata 2006) Installation of Oil Burning Equipment

NFPA 54 (2006) National Fuel Gas Code

NFPA 90A (2002; Errata 2003; Errata 2005) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 14 (2007) Plastics Piping System Components and Related Materials

NSF 61 (2007) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1998) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G 101 (1996) Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data

PDI WH 201 (2006) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (1997) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430 Energy Conservation Program for Consumer Products

PL 102-486 (1992) Residential Energy Efficiency Ratings

UNDERWRITERS LABORATORIES (UL)

UL 174 (2004; Rev thru May 2006) Household Electric Storage Tank Water Heaters

UL 1951 (1994; Rev thru Oct 2003) Standard for Electric Plumbing Accessories

UL 499 (2005; Rev thru Mar 2006) Electric Heating Appliances

UL 732 (1995; Rev thru Feb 2005) Oil-Fired Storage Tank Water Heaters

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code.. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush valve water closets

Flush valve urinals

Pressure Assist water closets

Wall hung lavatories

Countertop lavatories

Kitchen sinks

Service sinks

Drinking-water coolers

Plastic bathtubs

Plastic shower stalls

Plastic bathtub liners

Plastic bathtub wall surrounds

Water heaters

Pumps

Backflow prevention assemblies

Shower Faucets

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05 05 23 WELDING, STRUCTURAL. Structural members shall be welded in accordance with Section 05 05 23 WELDING, STRUCTURAL.

1.5.2 Plumbing Fixtures

Water flow and consumption rates shall at a minimum comply with requirements in PL 102-486.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC NCPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Pipe threads (except dry seal) shall conform to ASME B1.20.1. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply

with PL 93-523 and NSF 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums.

2.1.1 Pipe Joint Materials

Hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

d. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

f. Solder Material: Solder metal shall conform to ASTM B 32.

g. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

i. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

j. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

k. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.

l. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be diaphragm or piston type.

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Asphalt Roof Cement: ASTM D 2822.

d. Hose Clamps: SAE J1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

l. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 2-1/2 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70

Description	Standard
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Yard Hydrants

Shall be suitable for potable water. Yard box or post hydrants shall have

valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

2.3.4 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.5 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC NCPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Lavatories

Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled. Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.

2.4.2 Automatic Controls

Provide automatic, sensor operated faucets and flush valves to comply with ASSE 1037 and UL 1951 for lavatory faucets, urinals, and water closets. Flushing and faucet systems shall consist of solenoid-activated valves with light beam sensors. Flush valve for water closet shall include an override pushbutton. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.4.3 Flush Valve Water Closets

ASME A112.19.2M, white vitreous china, siphon jet, elongated bowl, floor-mounted, floor outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for accessible water closets. Provide wax bowl ring including plastic sleeve. Water flushing volume of the water closet and flush valve combination shall not exceed 1.6 gallons per flush. Provide black solid plastic elongated open-front seat. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid. Provide piston type, oil operated, flush valve and wall support for salt water service.

2.4.4 Flush Valve Urinals

ASME A112.19.2M, white vitreous china, wall-mounted, wall outlet, integral trap, and extended side shields. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 1.0 gallon per flush. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.5 Accessible Flush Valve Type Urinals

ASME A112.19.2M, white vitreous china, wall-mounted, wall outlet, integral trap, 14 inches long from wall to front of flare, and ASME A112.19.5 trim. Provide large diaphragm (not less than 2.625 inches upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers), nonhold-open flush valve of chrome plated cast brass conforming to ASTM B 584, including vacuum breaker and angle

(control-stop) valve with back check. The water flushing volume of the flush valve and urinal combination shall not exceed 1.0 gallon per flush. Furnish urinal manufacturer's certification of conformance. Provide ASME A112.6.1M concealed chair carriers. Mount urinal with front rim a maximum of 17 inches above floor and flush valve handle a maximum of 44 inches above floor for use by handicapped on wheelchair. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.6 Pressure Assist Water Closets

ASME A112.19.2M, white vitreous china, siphon jet, elongated bowl, pressure assisted, floor-mounted, floor outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for assessible water closets. Gravity tank type water closets are not permitted. Provide wax bowl ring including plastic sleeve. Water flushing volume of the water closet shall not exceed 1.6 gallons per flush. Provide black solid plastic round open-front seat with cover.

2.4.7 Wall Hung Lavatories

ASME A112.19.2M, white vitreous china, straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Water flow rate shall not exceed 0.5 gpm when measured at a flowing water pressure of 60 psi. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset lavatory faucets.

2.4.8 Countertop Lavatories

ASME A112.19.2M, white vitreous china, self-rimming, minimum dimensions of 19 inches wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide aerator with faucet. Water flow rate shall not exceed 0.5 gpm when measured at a flowing water pressure of 60 psi. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor. Provide top mounted washerless centerset lavatory faucets.

2.4.9 Kitchen Sinks

ASME A112.19.3, 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 25 inches wide by 21 inches front to rear, 7 inch deep single compartment, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets with hose spray, and with 3.5 inch drain outlet. Provide aerator with faucet. Water flow rate shall not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide stainless steel drain outlets and stainless steel cup strainers. Provide 1.5 inch P-trap and drain piping to vertical vent piping. Provide top mounted washerless swing type sink faucets with hose spray.

2.4.10 Service Sinks

ASME A112.19.2M, white vitreous china with integral back and wall hanger

supports, minimum dimensions of 22 inches wide by 20 inches front to rear, with two supply openings in 10 inch high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 0.75 inch external hose threads.

2.4.11 Drinking-Water Coolers

ARI 1010 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor and basin, and stainless steel cabinet. Bubblers shall be controlled by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 36 inches above floor and at front of unit basin. Spouts shall direct water flow at least 4 inches above unit basin and trajectory parallel or nearly parallel to the front of unit.

2.4.12 Accessible Drinking Water cooler

ARI 1010, dual height, ADA compliant, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled R134A refrigeration unit, 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet. Low bowl bubbler shall have 27 inch minimum knee clearance from front bottom of unit to floor and 36 inch maximum spout height above floor. High bowl/bubbler shall have 39 inch spout height. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet.

2.4.13 Plastic Bathtub/Shower Units

IAPMO Z124.1.2 four piece white solid acrylic pressure molded fiberglass reinforced plastic bathtub/shower units. Units shall be scratch resistant, waterproof, and reinforced. Provide recessed type units approximately 60 inches wide, 30 inches front to rear, 72 inches high with 15 inches high rim for through-the-floor drain installation with unit bottom or feet firmly supported by a smooth level floor. Provide left or right drain outlet units as required. Units shall have built-in soap dish and minimum of 12 inch long stainless steel horizontal grab bar located on back wall for standing use. Units shall meet performance requirements of IAPMO Z124.1.2 and shall be labeled by NAHB Research Foundation, Inc. for compliance. Install unit in accordance with the manufacturer's written instructions. Finish installation by covering unit attachment flanges with wall board in accordance with unit manufacturer's recommendation. Provide smooth 100 percent silicone rubber white bathtub calk between the unit and the adjacent walls and floor surfaces.

2.4.14 Plastic Shower Stalls

IAPMO Z124.1.2 four piece white solid acrylic pressure molded fiberglass reinforced plastic shower stalls. Shower stalls shall be scratch resistant, waterproof, and reinforced. Provide recessed type shower stalls approximately 36 inches wide, 36 inches front to rear, 76 inches high, and 5 inch high curb with shower stall bottom or feet firmly supported by a smooth level floor. Provide PVC shower floor drains and stainless steel strainers. Shower stalls shall meet performance requirements of IAPMO Z124.1.2 and shall be labeled by NAHB Research Foundation, Inc. for compliance. Install shower stall in accordance with the manufacturer's written instructions. Finish installation by covering shower stall

attachment flanges with dry-wall in accordance with shower stall manufacturer's recommendation. Provide smooth 100 percent silicone rubber white bathtub calk between the top, sides, and bottom of shower stalls and bathroom walls and floors.

2.4.15 Plastic Bathtub Liners

IAPMO Z124.8 one piece white plastic bathtub liners. Existing bathtubs shall be identified and measured to insure proper identification in order that each new bathtub liner shall be custom molded to fit the exact contours of the existing bathtubs. Provide left or right drain outlet bathtub liners as required. Bathtub liners shall be inserted over and into the existing bathtubs without disturbing the existing ceramic tile wainscot walls and existing floor material. Prepare the existing cast-iron bathtubs, ceramic tile wainscots, and floor to receive the new bathtub liners in accordance with the bathtub liner manufacturer's written instructions. Installation personnel shall be trained by the bathtub liner manufacturer. Seal the bathtub liner to existing bathtub with waterproof adhesive as required to keep moisture out from behind the bathtub liner. Provide smooth white waterproof bathtub sealant between bathtub drains, bathtub, and bathtub liners. Provide replacement chromium-plated overflow cover plates and push-pull bathtub drain stopper assembly. Provide smooth 100 percent silicone rubber white bathtub calk between the bathtub liner and the adjacent walls and floor surfaces in accordance with the bathtub liners manufacturer's written instructions.

2.4.16 Plastic Bathtub Wall Surrounds

IAPMO Z124.1.2 three piece white sectional pressure molded fiberglass plastic bathtub wall surrounds suitable for installation with existing bathtubs which are approximately 60 inches wide by 30 inches front to rear. Wall surrounds shall have built-in soap dish and minimum of 12 inch long stainless steel horizontal grab bar located on back wall for standing use. Bathtub wall surrounds shall meet performance requirements of IAPMO Z124.1.2 and shall be labeled by NAHB Research Foundation, Inc. for compliance. Install bathtub wall surrounds in accordance with the manufacturers written instructions. Finish installation by covering bathtub wall surround attachment flanges with dry-wall in accordance with bathtub wall surround manufacturer's recommendations. Provide smooth 100 percent silicone rubber white bathtub calk between the bathtubs and the adjacent walls and floor surfaces.

2.4.17 Precast Terrazzo Shower Floors

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.4.18 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.4.19 Bathtubs, Cast Iron

ASME A112.19.1M, white enameled cast iron, recessed type, minimum

dimensions of 60 inches wide by 30 inches front to rear by 16 inches high with drain outlet for above-the-floor drain installation. Provide left or right drain outlet bathtub as indicated.

2.4.20 Bathtubs, Porcelain

ASME A112.19.4M, white porcelain bonded to enameling grade metal, bonded to a structural composite, recessed type, minimum dimensions of 60 inches wide by 30 inches front to rear by 16 inches high with drain outlet for above-the-floor drain installation. Provide left or right drain outlet bathtub as indicated.

2.4.21 Emergency Eyewash and Shower

ISEA Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

2.4.22 Emergency Eye and Face Wash

ISEA Z358.1, wall-mounted self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 3 gpm of aerated water at 30 psig flow pressure, with eye and face wash nozzles 33 to 45 inches above finished floor. Provide copper alloy control valves. Provide an air-gap with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the North Carolina Plumbing Code minimum. Provide a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 60 to 95 degrees F. Provide packaged, UL listed, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow service within NEMA Type 3 or 4 enclosures and for explosion proof service within NEMA Type 7 or 9 enclosures.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall

have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping where noted on the drawings. Primer shall meet ASSE 1018.

2.6.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws securing the clamping device shall be provided. Polyethylene drains shall have fittings to adapt drain to waste piping. Polyethylene for floor drains shall conform to ASTM D 1248. Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and strainer, unless otherwise indicated.

2.6.1.2 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Bathtub and Shower Faucets and Drain Fittings

Provide single control pressure equalizing bathtub and shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads. Provide shower heads which deliver a maximum of 2.2 GPM at 80 PSI per Energy Star requirements. Provide tubing mounted from behind the wall between bathtub faucets and shower heads and bathtub diverter spouts. Provide separate globe valves or angle valves with union connections in each supply to faucet. Provide push-pull stopper drain fittings for above-the-floor drain installations. The top of drain pop-ups, drain outlets, tub overflow outlet, and; control handle for pop-up drain shall be chromium-plated or polished stainless steel. Provide 1.5 inch copper alloy adjustable tubing with slip nuts and gaskets between bathtub overflow and drain outlet; chromium-plated finish is not required. Provide bathtub and shower valve with ball type control handle.

2.6.3 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping where noted on the drawings. Primer shall meet ASSE 1018.

2.6.4 Floor Sinks

Floor sinks shall be circular, square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum

sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.5 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.6.6 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar 36 square inches

Height of funnel 3-3/4 inches

Diameter of lower portion 2 inches of funnel

Diameter of upper portion 4 inches of funnel

2.6.7 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.21.2M, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less

than 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.7 SHOWER PAN

Shower pan may be copper, or nonmetallic material.

2.7.1 Sheet Copper

Sheet copper shall be 16 ounce weight.

2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 0.040 inch minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and shall be in accordance with ASTM D 4551.

2.7.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material

Material shall consist of a plastic waterproofing membrane in sheet form. The material shall be 0.040 inch minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. or ASTM D 638:

Ultimate Tensile Strength:	2600 psi
Ultimate Elongation:	398 percent
100 Percent Modulus:	445 psi

b. ASTM D 1004:

Tear Strength:	300 pounds per inch

c. ASTM E 96:

Permeance:	0.008 perms

d. Other Properties:

Specific Gravity:	1.29
PVC Solvent:	Weldable
Cold Crack:	minus -53 degrees F
Dimensional stability, 212 degrees F minus 2.5 percent	
Hardness, Shore A:	89

2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409. Traps shall be without a cleanout. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout.

2.9 INTERCEPTORS

2.9.1 Manufactured Grease Interceptor

Grease interceptor of the size indicated shall be commercially available steel grease interceptor with removable three-section, 3/8 inch checker-plate cover, and shall be installed where shown. Steel grease interceptor shall be epoxy-coated to resist corrosion as recommended by the manufacturer. Interceptors shall be tested and rated in accordance with PDI G 101. Provide flow control fitting.

2.9.2 Manufactured Oil Interceptor

Cast iron or welded steel, coated inside and outside with white acid resistant epoxy, with internal air relief bypass, bronze cleanout plug, double wall trap seal, removable combination pressure equalizing and flow diffusing baffle and sediment bucket, horizontal baffle, adjustable oil draw-off and vent connections on either side, gas and watertight gasketed nonskid cover, and flow control fitting.

2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume shall be as indicated.

2.10.1 Automatic Storage Type

Heaters shall be complete with control system and shall have ASME rated combination pressure and temperature relief valve.

2.10.1.1 Oil-Fired Type

Oil-fired type water heaters shall conform to UL 732.

2.10.1.2 Gas-Fired Type

Gas-fired water heaters shall conform to CSA/AM Z21.10.1 when input is 75,000 BTU per hour or less or CSA/AM Z21.10.3 for heaters with input greater than 75,000 BTU per hour.

2.10.1.3 Electric Type

Electric type water heaters shall conform to UL 174. Unless noted

otherwise, heaters shall have dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time.

2.10.1.4 Indirect Heater Type

Steam and high temperature hot water (HTHW) heaters with storage system shall be the assembled product of one manufacturer, and be ASME tested and "U" stamped to code requirements under ASME BPVC SEC VIII D1. The storage tank shall be as specified in paragraph HOT-WATER STORAGE TANKS. The heat exchanger shall be double wall, single wall type that separates the potable water from the heat transfer medium with a space vented to the atmosphere in accordance with ICC NCPC.

a. Steam Energy Source: The heater element shall have a working pressure of 150 pounds per square inch gauge (psig) with steam at a temperature of 365 degrees F. The heating surface shall be based on a fouling factor of .001. Cast iron or bronze heads shall be used. Tubing shall be light-drawn copper tubing conforming to ASTM B 75. Heating elements shall withstand an internal hydrostatic pressure of 250 psig for not less than 15 seconds without leaking or any evidence of damage.

2.10.2 Instantaneous Water Heater

Heater shall be crossflow design with service water in the coil and steam, hot water in the shell. An integral internal controller shall be provided, anticipating a change in demand so that the final temperature can be maintained under all normal load conditions when used in conjunction with pneumatic control system, pilot-operated temperature control system. Normal load conditions shall be as specified by the manufacturer for the heater. Unit shall be manufactured in accordance with ASME BPVC SEC VIII D1, and shall be certified for 150 psi working pressure in the shell and 150 psi working pressure in the coils. Shell shall be carbon steel with copper lining. Heads shall be cast iron or bronze. Coils shall be copper, copper-nickel. Shell shall have metal sheathed fiberglass insulation, combination pressure and temperature relief valve, and thermometer. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.10.3 Electric Instantaneous Water Heaters (Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.11 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1 - IP. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 7 inch scale. Thermometer shall be installed in a dry well. Tanks shall be equipped with a pressure gauge 6 inch minimum diameter face. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.12 PUMPS

2.12.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

2.12.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an electrical disconnecting means. Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

2.12.3 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.12.4 Sewage Pumps

Provide single type, duplex type with automatic controls to alternate the operation from one pump to the other pump and to start the second pump in the event the first pump cannot handle the incoming flow. Provide high water alarm and check valve.

2.13 WATER PRESSURE BOOSTER SYSTEM

2.13.1 Constant Speed Pumping System

Constant speed pumping system with pressure-regulating valves shall employ one lead pump for low flows, and one or more lag pumps for higher flows. Pressure-regulating valves shall be provided with nonslam check feature. The factory prepiped and prewired assembly shall be mounted on a steel frame, complete with pumps, motors, and automatic controls. The system capacity and capacity of individual pumps shall be as indicated. Current sensing relays shall provide staging of the pumps. The pumps shall be protected from thermal buildup, when running at no-flow, by a common thermal relief valve. Pressure gauges shall be mounted on the suction and

discharge headers. The control panel shall bear the UL listing label for industrial control panels and shall be in a NEMA 250, Type 1 enclosure. The control panel shall include the following: No-flow shutdown; 7-day time clock; audiovisual alarm; external resets; manual alternation; magnetic motor controllers; time delays; transformer; current relays; "HAND-OFF-AUTOMATIC" switches for each pump; minimum run timers; low suction pressure cutout; and indicating lights for power on, individual motor overload, and low suction pressure. The control circuit shall be interlocked so that the failure of any controller shall energize the succeeding controller.

2.13.2 Hydro-Pneumatic Water Pressure System

An ASME code constructed tank stamped for 125 psig water working pressure shall be provided. The tank shall have a flexible diaphragm made of material conforming to FDA requirements for use with potable water and shall be factory precharged to meet required system pressure.

2.13.3 Variable Speed Pumping System

Variable speed pumping system shall provide system pressure by varying speed and number of operating pumps. The factory prepiped and prewired assembly shall be mounted on a steel frame complete with pumps, variable speed drives, motors, and controls. The variable speed drives shall be the oil-filled type capable of power transmission throughout their complete speed range without vibration, noise, or shock loading. Each variable speed drive shall be run-tested by the manufacturer for rated performance, and the manufacturer shall furnish written performance certification. System shall have suppressors to prevent noise transmission over electric feed lines. Required electrical control circuitry and system function sensors shall be supplied by the variable speed drive manufacturer. The primary power controls and magnetic motor controllers shall be installed in the controls supplied by the drive manufacturer, the motor control center. The sensors shall be located in the system to control drive speed as a function of constant pump discharge pressure, constant system pressure at location indicated. Connection between the sensors and the variable speed drive controls shall be accomplished with hydraulic sensing lines, copper wiring, telemetry. Controls shall be in NEMA 250, Type 1 enclosures.

2.14 COMPRESSED AIR SYSTEM

2.14.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including _____ phase, _____ volt motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 1, 4 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system, regulate pressure by constant speed compressor loading and unloading, have a manual-off-automatic switch that when in the manual position, the compressor loads and unloads to meet the demand and, in the automatic position, a time delay relay shall allow the compressor to operate for an adjustable length of time unloaded, then stop the unit. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with automatic, manual alternation system. Each compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage

release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensate before the air enters the receiver. Aftercoolers shall be either air- or water-cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve, which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.14.2 Air Receivers

Receivers shall be designed for 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPVC SEC VIII D1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

2.14.3 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns.

2.14.4 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi. Regulator shall be sized as indicated.

2.15 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register shall be indicating, round or straight reading type. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

2.16 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 16415A ELECTRICAL WORK, INTERIOR, Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are

part of a system, corresponding to the applications in accordance with NEMA MG 11. Where indicated on drawings, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 16415A ELECTRICAL WORK, INTERIOR, Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.17 MISCELLANEOUS PIPING ITEMS

2.17.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.17.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

2.17.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.17.3 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.17.4 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.17.5 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve or full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except as allowed by NCPC. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied

with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as

required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2 inches and smaller; flanges shall be used on pipe sizes 2-1/2 inches and larger.

3.1.3.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.4 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air comppressor and the receiver.

3.1.3.5 Plastic Pipe

PVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and

vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete, masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.5.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs,

flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.7.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.7.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.8 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe

to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.9 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron or plastic.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Installation of Gas- and Oil-Fired Water Heater

Installation shall conform to NFPA 54 for gas fired and NFPA 31 for oil fired.

3.2.3 Heat Traps

Provide integral, factory manufactured or piping arranged heat traps on piping to and from each water heater and hot water storage tank on both hot and cold water connection. Piping arranged heat trap shall incorporate a minimum 12 inch deep loop to restrict natural tendency of hot water to rise during standby periods.

3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.5 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.2.6 Direct Fired and Domestic Water Heaters

Notify the Contracting Officer when any direct fired domestic water heater over 117,124.2 Watts (400,000 BTU/hour) is operational and ready to be inspected and certified.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be

installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.

3.3.3 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.4.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC NCPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05 50 00 METAL: MISCELLANEOUS AND FABRICATIONS.

3.3.7 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.3.8 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.3.9 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

3.3.9.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 6 inches for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall

be clamped to drains with the drain clamping ring.

3.3.9.2 Nonplasticized Chlorinated Polyethylene Shower Pans

Corners of nonplasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled 1/2 inch from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane. Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding 1/2 inch from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below 40 degrees F the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of 15 pound dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.

3.3.9.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 6 inches in room areas and 3 inches above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 1 inch of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 2 inches. Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 2 or 3 feet at a time shall be welded. On wood subflooring, two layers of 15 pound felt shall be installed prior to installation of shower pan to ensure a smooth surface

installation.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to _____ percent of the lowest equipment rpm.

3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer. Compressors shall be mounted to resist seismic loads as specified in Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.4.2 Foundation-Mounted Compressors

Foundation attachment shall be as recommended by the compressor manufacturer. Foundation shall be as recommended by the compressor manufacturer, except the foundation shall weigh not less than three times the weight of the moving parts. Compressors shall be mounted to resist seismic loads as specified in Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in

concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.8.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.8.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC NCPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests. (Pressure tests shall use water - do not use air pressure)

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 Unfired Pressure Vessel

All unfired vessels such as air receivers greater than 5 cubic feet (37 gallons) in volume or grater than 250 psig shall be hydrostatically and operationally tested on site in accordance with ASME National Board of Boiler and Pressure Vessel Inspectors Code and NAVFAC MO0324 Inspection and Certification of Boilers and Unfired Pressure Vessels. Hydrastatic and operational test to be witnessed by OICC representative and Camp Lejeune Boiler Inspector. Hydrostatic pressure test shall be at 1.5 times the M.A.W.P. for ASME Div I vessels an 1.25 times the M.A.W.P. for ASME Div II vessels.

3.9.1.3 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop

in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.9.1.4 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with clean water to 150 psig and hold this pressure for 2 hours with no drop in pressure. After completion of the pressure test drain all of the water from all of the system.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with hot potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration.

3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Coordinate operational test and equipment installation with commissioning as specified in Section 01 91 00 COMMISSIONING. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.9.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained from a certified testing laboratory.

3.10 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = o (trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

3.12.1 Storage Water Heaters

3.12.1.1 Electric

a. Storage capacity of 120 gallons or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.

b. Storage capacity of more than 120 gallons or input rating more than 12 kW: maximum SL shall be 1.9 W/sq. ft. per ASHRAE 90.1 - IP, Addenda B.

3.12.1.2 Gas

a. Storage capacity of 100 gallons or less, and input rating of 75,000 Btu/h or less: minimum EF shall be 0.62, 0.80-0.0019V per

10 CFR 430.

b. Storage capacity of more than 100 gallons - or input rating more than 75,000 Btu/h: Et shall be 77 percent; maximum SL shall be 1.3+38/V, per CSA/AM Z21.10.3.

3.12.1.3 Oil

a. Storage capacity of 50 gallons or less and input rating of 105,000 Btu/h or less: minimum EF shall be 0.80-0.0019V per 10 CFR 430.

b. Storage capacity of more than 50 gallons or input rating more than 105,000 Btu/h: EC shall be 83 percent; maximum SL shall be 1.3+38/V, per 10 CFR 430.

3.12.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

3.12.3 Instantaneous Water Heater

3.12.3.1 Gas

Volumes and inputs: ET shall be 80 percent per CSA/AM Z21.10.3.

3.12.3.2 Oil

Capacities and inputs: EC shall be 83 percent per CSA/AM Z21.10.3.

3.12.4 Pool Heaters

Gas/oil fuel, capacities and inputs: ET shall be 78 percent per CSA/AM Z21.56.

3.13 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X	X	

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	B	C	D	E	F
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
6	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B	X			X	X	
7	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	
8	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X	
9	Seamless copper pipe, ASTM B 42				X		
10	Cast bronze threaded fittings, ASME B16.15				X	X	
11	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
12	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
13	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665,	X	X	X	X	X	X
14	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M		X			X	X

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F
	F - Corrosive Waste And Vent Above And Belowground						
	* - Hard Temper						

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X	
2	Steel pipe: a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B			X	
3	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
4	Seamless copper pipe, ASTM B 42	X	X		X
5	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
6	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
7	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
8	Cast copper alloy solder-joint pressure fittings,	X	X	X	X

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE A	B	C	D
	ASME B16.18 for use with Item 8				
9	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
10	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83			X	
11	Malleable-iron threaded pipe unions ASME B16.39			X	
12	Nipples, pipe threaded ASTM A 733			X	
13	Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F 877.	X*			X*

A - Cold Wat0r Service Aboveground
B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground
C - Compressed Air Lubricated
D - Cold Water Service Belowground
Indicated types are minimum wall thicknesses.
* - PEX shall only be used where called for on the drawings
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors
**** - In or under slab floors only brazed joints

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Elect.	120 max.	12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	120 min. OR	12 kW min.	ASHRAE 90.1 - IP (Addenda B)	SL = 1.9 W/sq. ft. maximum
Gas	100 max.	75,000 Btu/h	10 CFR 430	EF = 0.62, 80-0.0019V

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS		INPUT RATING max.	TEST PROCEDURE	REQUIRED PERFORMANCE minimum
Gas	100 min.	OR	75,000 Btu/h	CSA/AM Z21.10.3	ET = 80 percent; SL = 1.3+38/V max.
Oil	50 max.		105,000 Btu/h	10 CFR 430	EF = 0.80-0.0019V minimum
Oil	51 min.	OR	105,000 Btu/h	10 CFR 430	EC = 83 percent; SL = 1.3+38/V maximum

B. Unfired Hot Water Storage, instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

C. Instantaneous Water Heater

Gas	All	All	CSA/AM Z21.10.3	ET = 80 percent
Oil	All	All	CSA/AM Z21.10.3	EC = 83 percent

D. Pool Heater

Gas or Oil	All	All	CSA/AM Z21.56	ET = 78 percent

TERMS:

EF = Energy factor, overall efficiency.
ET = Thermal efficiency with 70 degrees F delta T.
EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).
SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.
HL = Heat loss of tank surface area
V = Storage volume in gallons

-- End of Section --

SECTION 23 03 00

BASIC MECHANICAL MATERIALS AND METHODS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998; Errata 1999) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 15, "Mechanical" of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 26 20 00, "Interior Distribution System." Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00, "Interior Distribution System."

1.6 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 16, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.6.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 16.

1.6.3 High Efficiency Motors

1.6.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.6.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors, except motors integral to equipment with a total efficiency rating, shall be selected based on premium efficiency characteristics relative to the applications as listed

in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.6.4 Three-Phase Motor Protection

Provide controllers for 3 phase motors rated one horsepower (.75 kilowatts) and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

1.9 EQUIPMENT INVENTORY UPDATE

Submit information for each piece of equipment removed and supplied for use of Camp Lejeune to update the Maximo equipment inventory. For the purposes of this paragraph, inventoried equipment is defined as equipment listed on the Maximo Equipment Inventory Update form.

1.9.1 Requirements

The contractor shall prepare and submit one Maximo Equipment Inventory Update form for each individual item of inventoried equipment that is demolished, removed, replaced, or installed. (ex: three new condensing units would require the submission of three Equipment Inventory Update forms. The replacement of two existing air handling units with two new air handling units would require the submission of two Equipment Inventory Update forms). The contractor shall prepare and submit a VAV/TAB Room Number List for each VAV/Tab model installed in a single building. Only one Maximo Equipment Inventory Update form is required for each model of

VAV or TAB in a single building.

1.9.1.1 Demolition of all equipment in a structure or facility

When all the inventoried equipment in a building or structure is demolished or removed, and not replaced, an Equipment Inventory Update form is not required.

1.9.1.2 Standards

The contractor shall provide accurate, complete, and legible information on all required forms. All required forms shall be completed and delivered to the Contracting Officer on or before the Beneficial Occupancy Date. All information on Equipment Inventory Update forms shall be obtained by visual inspection of equipment data plate(s).

1.9.1.3 Form Preparation

Each required Maximo Equipment Inventory Update form shall contain the following information:

(1) The name and telephone number of an individual who can be contacted for clarification or additional information pertaining to the data on the form.

(2) The date of data collection

(3) The building or structure identification number and the specific location of the equipment within the structure (ex: 3d deck mech room)

(4) A check adjacent to the description of the new or replacement item, and a check adjacent to the supplemental description if applicable (ex: circulating pump and HVAC or steam)

(5) The Maximo number or serial number of the demolished or removed item, if applicable

(6) All applicable data from the equipment data plate

Each Room Number List form shall contain the following information:

(1) The name and telephone number of the individual providing the information

(2) The date the form was completed

(3) The building or structure identification number

(4) A check in the box adjacent to each applicable room number

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall

be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

MAXIMO EQUIPMENT INVENTORY UPDATE

Employee: _____ Phone: _____ Date: ____/____/____

Bldg: _____ Specific Location: _____

__ AC, Computer Room
__ AC, Package
__ AC, Package Terminal
__ Assembly, Trap line
__ Backflow Preventer
__ Boiler
__ Chiller, Air Cooled Recip
__ Chiller, Air Cooled Screw
__ Chiller, Air Cooled Scroll
__ Chiller, Water Cooled Recip
__ Chiller, Water Cooled Screw
__ Compressor, Control Air
__ Compressor, Industrial Air
__ Dryer, Refrigerated Air
__ Exchanger, Heat
__ Evaporator, Freezer
__ Evaporator, Refrigerator
__ Fan, Exhaust
__ Generator
__ Heater, Space
__ Heater, Unit
__ Heat Pump, Geo-Thermal
__ Heat Pump, Indoor Unit
__ Heat Pump, Outdoor Unit
__ Heat Pump, Package
__ Heat Pump, Package Terminal
__ Pump, Circulating, Chilled Water
__ Pump, Circulating, Domestic Water
__ Pump, Circulating, Dual Temp Water
__ Pump, Circulating, Heating Water
__ Pump, Condensate
__ Pump, Sump
__ Regulator, Temperature
__ Tank, Hot Water Storage
__ Tower, Cooling
__ Unit, Air Handling
__ Unit, AC Condensing
__ Unit, Freezer Condensing
__ Unit, Refrigerator Condensing
__ Unit, Fan Coil
__ Unit, TAB (Attach Room No. List)
__ Unit, VAV (Attach Room No. List)
__ Valve, Pressure Reducing
__ Valve, Steam Pilot
__ Water Heater

Demolished/Removed Equipment

Maximo no: _____ or Ser no: _____

New Equipment

Manufacturer: _____

Model no: _____

Ser no: _____

Type: __Elec __Oil __LP Gas __Nat Gas __Steam __Water __Air

Motor Data: HP____ Volts____ Phase____ RLA_____ RPM____ Frame____

Tons____ No. of Motors____ no. of Belts____ Belt size(s)____ CFM____

KW____ Refrig type_____ Refrig Qty_____ Filter Size(s)_____

VAV/TAB Room Number List

Emplyee: _____ Phone: _____

Bldg: _____ Date: _____

VAV/TAB Model Number: _____

- ☐ 100
- ☐ 101
- ☐ 102
- ☐ 103
- ☐ 104
- ☐ 105
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- ☐ 375

Instructions

(1) Confirm room numbers by visual inspection
(2) Check the box next to each applicable room number

-- End of Section --

SECTION 23 05 92

TESTING/ADJUSTING/BALANCING: SMALL HEATING/VENTILATING/COOLING SYSTEMS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	1989 National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Procedural Stds	1991 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA TAB HVAC Sys	1993 HVAC Systems - Testing, Adjusting and Balancing

1.2 DESCRIPTION OF WORK

The work includes testing, adjusting, and balancing (TAB) of new and existing heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment, ducts, and piping which are located within, on, under, between, and adjacent to buildings.

1.2.1 Air Distribution Systems

Systems shall be tested, adjusted, and balanced (TAB'd) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems under Section 23 07 00, "Insulation for Mechanical Systems."

1.2.2 Water Distribution Systems

Systems shall be TAB'd in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems under Section 23 07 00, "Insulation for Mechanical Systems." At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd. Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device. For chilled water and chilled-hot water piping, the ends of pipe insulation and the space between ends of pipe insulation and piping shall be sealed with waterproof vapor barrier

coating. After completion of work under this section, the flow control valves and devices shall be insulated under Section 23 07 00, "Insulation for Mechanical Systems."

1.3 DEFINITIONS

a. TAB team supervisor: TAB team engineer.

b. TAB team technician: TAB team assistant.

c. Field check group: One or more systems of the same basic type; the subgroup of a "field check group" is a "system."

d. Out-of-tolerance data: Pertains only to field checking of certified DALT or TAB report. The term is defined as a measurement taken during field checking which does not fall within the range of plus 10 to minus 10 percent of the design for a specific parameter.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-06 Test Reports

Certified TAB Report

1.4.1 Certified TAB Report

Submit certified TAB report with a certification statement which attests that the procedures executed have been in full compliance with the requirements of NEBB Procedural Stds, AABC MN-1, or SMACNA TAB HVAC Sys. Certifications shall further attest that any/all known deficiencies in operation, performance, or water/air flows are clearly identified herein. The report shall be reported in the specified format including the following data:

a. Report Format: Submit completed report forms for each of the following; as a minimum, report all data as contained on standard NEBB Procedural Stds, AABC MN-1, OR SMACNA TAB HVAC Sys report forms as contained within the referenced standards:

(1) Air Systems

(a) Fan report for rooftop units, central air handlers, exhaust fans, fan coil units, heat pumps, packaged terminal units.

(b) Duct traverse supply/return/exhaust/relief ducts.

(c) Terminal supply, return, and exhaust outlets.

(d) Hot/chilled water coils - report entering/leaving, wet/dry bulb temperatures.

(e) DX cooling coils - reports entering/leaving, wet/dry bulb temperatures.

(f) Unit heaters.

(g) Condensing units/compressors/condensors - report rated/actual compressor amperages/voltages. Also, report condenser entering air temperature, both design and actual.

(2) Water Systems

(a) All pumps.

(b) All flow control balancing valves, circuit setters, flow orifices, venturis - report size, flow, measured pressure drop, setting, manufacturer, model.

(c) Hot water, chilled water coils.

(d) Hot water converters, heat exchangers.

(e) Unit heaters, convectors, fan coil units, fin tube radiation.

The report shall be neatly bound with a waterproof cover. It shall contain a table of contents, with each page numbered. All report data shall be typed - handwritten data will not be acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within the TAB data was recorded.

c. Instruments: List the types of instruments actually used to measure the TAB data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

1.5 QUALITY ASSURANCE

1.5.1 Modifications of References

Accomplish work in accordance with referenced publications of AABC or NEBB except as modified by this section. In the references referred to herein, consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may" wherever they appear. Interpret reference to the "authority having jurisdiction," the "Administrative Authority," the "Owner," or the "Design Engineer" to mean the "Contracting Officer."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 TAB PROCEDURES

3.1.1 TAB Field Work

Test, adjust, and balance the listed HVAC systems to the state of operation indicated on and specified in the contract design documents. Air

systems and water systems shall be proportionately balanced and reported in the certified TAB report. Provide instruments and consumables required to accomplish the TAB work. Conduct TAB work, including sound measurement work, on the listed HVAC systems in conformance with the AABC MN-1, or NEBB Procedural Stds, except as modified by this section:

a. Workmanship: Conduct TAB work on specified HVAC systems until measured parameters are within plus or minus 10 percent of the design values, that is, the values specified or indicated on the contract documents.

3.1.2 Data From TAB Field Work

After all TAB work has been completed, prepare a handwritten certified, pre-final TAB report using all report forms complete as specified for the final certified TAB report. Except as approved otherwise by the Contracting Officer, in writing, the TAB work and the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph titled "Workmanship."

3.1.3 Quality Assurance For TAB Field Work

3.1.3.1 Field Check

Verbally notify the Contracting Officer that the field check of the pre-final, handwritten report can commence; give this verbal notice 48 hours in advance of when the field check of the pre-final report can commence. Do not schedule the field check of the pre-final report until the TAB work is accomplished to within the accuracy range specified in the paragraph titled "Workmanship" or written approval of the deviations from the requirements has been received from the Contracting Officer.

a. Recheck: During field check the Contractor shall recheck, in the presence of the Contracting Officer, random selections of all reported data recorded in the pre-final report.

b. Areas of Recheck: Points and areas of recheck shall be selected by the Contracting Officer.

c. Procedures: Measurements and test procedures shall be the same as was used for forming basis of the pre-final report.

d. Recheck Selections: Selections for recheck will not exceed 25 percent of the total number of reported data entries tabulated in the pre-final report.

3.1.3.2 Retests

If random tests reveal a measured value which is an out-of-tolerance quantity, the report is subject to disapproval at the Contracting Officers' discretion. In the event the report is disapproved, all systems shall be readjusted and tested; new data recorded; a new pre-final report submitted; and a new field check conducted at no additional cost to the Government.

3.1.3.3 Out-of-Tolerance Quantity

Out-of-tolerance quantity pertains to field checking of the pre-final report. The term is defined as measurement taken during field checking which does not fall within the range of plus 10 to minus 10 percent of the

design for the specific parameter.

3.1.3.4 Report Acceptance

On completion, and approval, of the pre-final report field check, the Contractor shall prepare, assemble, and submit the final certified TAB report in the required format for final review/approval.

3.2 MARKING OF SETTINGS

Permanently mark the settings of HVAC adjustment devices including valves, splitters, and dampers so that adjustment can be restored if disturbed at any time. The permanent markings shall indicate the settings on the adjustment devices which result in the data reported on the submitted certified TAB report.

3.3 MARKING OF TEST PORTS

The TAB team shall permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, these markings shall be made on the exterior side of the duct insulation. The location of test ports shall be shown on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

SECTION 23 07 00

INSULATION OF MECHANICAL SYSTEMS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 240/A 240M	(1996) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 177	(1985; R 1997) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Preformed Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polisocyanrate Thermal Insulation
ASTM C 592	(1980) Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)

ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 916	(1985; R 1990) Adhesives for Duct Thermal Insulation
ASTM C 1136	(1995) Flexible, Low permeance Vapor Retarders for Thermal Insulation
ASTM D 828	(1993) Tensile Breaking Strength of Paper and Paperboard
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 96	(1997; Rev A) Water Vapor Transmission of Materials

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS L-P-535	(Rev. E; Notice 2) Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) and Poly(Vinyl Chloride-Vinyl Acetate), Rigid

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-3316	(Rev. C; Am. 2) Adhesives, Fire-Resistant, Thermal Insulation
MIL-C-19565	(Rev. C; Am. 1) Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor Barrier
MIL-C-20079	(Rev. H) Cloth, Glass: Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
MIL-A-24179	(Rev. A) (Valid Notice 1) Adhesive, Flexible Unicellular-Plastic Thermal Insulation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 255	(1996) Surface Burning Characteristics of Building Materials

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996) Surface Burning Characteristics of Building Materials

1.2 SYSTEM DESCRIPTION

Provide new and modify existing field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems which are located within, on, under, and adjacent to buildings; and for plumbing piping systems.

1.2.1 Air Distribution System

Obtain Contracting Officer's written approval of systems under Section 23 05 92, "Testing/Adjusting/Balancing: Small Heating/Ventilating/Cooling Systems" before applying field-applied insulation to air distribution systems.

1.2.2 Piping Systems

Obtain Contracting Officer's written approval of HVAC water distribution systems under Section 23 05 92, "Testing/Adjusting/Balancing: Small Heating/Ventilating/Cooling Systems" before applying field-applied insulation to HVAC water distribution systems. At the Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are tested, adjusted, and balanced (TAB'd). Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device. For chilled water and chilled-hot water piping, the ends of pipe insulation and the space between ends of pipe insulation and piping shall be sealed with waterproof vapor barrier coating. After systems are TAB'd, the control valves and devices shall be insulated.

1.3 DEFINITIONS

1.3.1 Finished Spaces

Spaces used for habitation or occupancy where rough surfaces are plastered, panelled, or otherwise treated to provide a pleasing appearance.

1.3.2 Unfinished Spaces

Spaces used for storage or work areas where appearance is not a factor, such as unexcavated spaces and crawl space.

1.3.3 Concealed Spaces

Spaces out of sight. For example, above ceilings; below floors; between double walls; furred-in areas; pipe and duct shafts; and similar spaces.

1.3.4 Exposed

Open to view. For example, pipe running through a room and not covered by other construction.

1.3.5 Fugitive Treatments

Treatment subject to deterioration due to aging, moisture, high humidity, oxygen, ozone, and heat. Fugitive materials are entrapped materials that can cause deterioration, such as solvents and water vapor.

1.3.6 Outside

Open to view up to 5 feet beyond the exterior side of walls, above the roof, and unexcavated or crawl spaces.

1.3.7 Conditioned Space

An area, room or space normally occupied and being heated or cooled for

human habitation by any equipment.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-03 Product Data

Piping insulation

Piping insulation finishes

Heating, ventilating, and air conditioning systems insulation

Duct insulation finishes

Accessory materials

Adhesives, sealants, and coating compounds

1.5 QUALITY ASSURANCE

Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site shall have the manufacturer's stamp or label attached giving name of manufacturer, brand and description of material. Insulation packages and containers shall be asbestos-free.

1.6 FLAME-SPREAD AND SMOKE-DEVELOPED RATINGS

In accordance with NFPA 255, ASTM E 84 or UL 723, the materials shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50.

1.6.1 Materials Tests

Test factory-applied materials as assembled. Field-applied materials may be tested individually. Use no fugitive or corrosive treatments to impart flame resistance. UL label or satisfactory certified test report from a testing laboratory will be required to indicate that fire hazard ratings for materials proposed for use do not exceed those specified. Flame-proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.

1.6.2 Materials Exempt From Fire-Resistant Rating

Nylon anchors.

PART 2 PRODUCTS

2.1 PIPING INSULATION

Piping systems, except buried pipe requiring insulation, types of insulation required, and insulation thickness shall be as listed in Tables I herein. Unless otherwise specified, insulate all fittings, flanges, and valves, except valve stems, hand wheels, and operators. Provide factory premolded, precut, or field-fabricated insulation of the same thickness and conductivity as insulation on adjacent piping. Insulation exterior shall

be factory cleanable, grease resistant, non-flaking and non-peeling. Pipe insulation shall conform to the referenced publications.

2.1.1 Buried Water Pipe Insulation

Section 33 61 14, "Exterior Buried Preinsulated Water Piping."

2.1.2 Buried Steam and Condensate Return Pipe Insulation

Section 33 61 13, "Pre-Engineered Underground Heat Distribution System," Section 33 60 02, "Aboveground Heat Distribution System," Section 33 63 23, "Exterior Aboveground Steam Distribution," and Section 33 63 14, "Exterior Buried Pumped Condensate Return".

2.1.3 Pipe Insulation Beyond Building Walls

For 5 feet beyond the exterior side of building walls, conform to Section 22 07 10.00 20, "Exterior Piping Insulation," in tunnels, in manholes, under and above piers, in trenches on piers, and for aboveground piping.

2.1.4 Flexible Unicellular Insulation

2.1.4.1 Recommended Adhesive

ASTM C 534. Provide adhesive as recommended by insulation manufacturer or conforming with MIL-A-24179, Type II, Class 1.

2.1.4.2 Polyolefin thermoplastic

Polyolefin thermoplastic meets ASTM C 534, except density.

2.1.4.3 Adhesive For Finishing Flexible Unicellular Insulation

MIL-A-3316, Class 1, Grade A.

2.1.4.4 Glass Cloth For Finishing Flexible Unicellular Insulation

MIL-C-20079, Type I, Class 1, 3, or 5.

2.1.5 Cellular Glass Insulation

ASTM C 552, Type II.

2.1.6 Cellular Phenolic Insulation

ASTM C 1136.

2.1.7 Mineral Fiber

ASTM C 547, Class I.

2.1.8 Calcium Silicate

ASTM C 533, Class I.

2.1.9 Piping Insulation Finishes

2.1.9.1 All-Purpose Jacket

Provide a factory applied all-purpose jacket when field applied jacketing is not specified. All purpose jackets shall include integral vapor barrier as required by service. Provide jackets in exposed locations with a white surface suitable for field painting. Allow a maximum water vapor permeance of 0.05 perm in accordance with ASTM E 96, a puncture resistance of not less than 50 Beach units, and a minimum tensile strength of 35 pounds-force per inch of width in accordance with ASTM D 828.

2.1.9.2 Vapor-Barrier Material

ASTM C 1136. Resistant to flame, moisture penetration, and mold growth. Provide vapor-barrier material on pipe insulation as required in Table I.

2.1.9.3 Metal Jackets

a. Aluminum Jackets: ASTM B 209, Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves and flanges.

b. Stainless Steel Jackets: ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 33 gage (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges.

c. Piping, Fittings, Flanges, and Valves in Outside Locations: Finish elbows and curved piping with factory-fabricated metal covers. Finish tees, flanges, and valves with metal covers. Covers shall be same thickness and material as jackets on adjacent piping.

2.2 HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS INSULATION

Provide insulation on ducts, plenums, mixing boxes, filter boxes, casings, and diffusers of Heating, Ventilating and Air Conditioning Systems (HVAC).)

2.2.1 Duct Insulation in Concealed Spaces

Blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3, 1.0 pound per cubic foot nominal, 2.0 inches thick. Provide flexible insulation in concealed spaces only.

2.2.2 Duct Insulation Not in Concealed Spaces

Mineral fiber in accordance with ASTM C 612, Class 2 (maximum surface temperature 400 degrees F), 6 pcf (pounds per cubic foot) average, one inch thick.

2.2.3 Exhaust Ductwork

For ovens, griddles, deepfat fryers, steam kettles, vegetable steamers, high pressure cookers, and mobile serving units, insulate ductwork with a minimum thickness of 2-inch blocks or boards, either mineral fiber conforming to ASTM C 612, Class 5, 20 pcf average or calcium silicate conforming to ASTM C 533, Type II.

2.2.4 All Types of Ductwork Located Outside

Provide ASTM C 591, polyisocyanurate or polyurethane board insulation, minimum density of 1.7 pcf, 1.5 inch thick, and weatherproof finish.

2.2.5 Acoustically Lined Ducts

For ductwork indicated or specified in Section 23 30 13.00 20, "Ductwork and Ductwork Accessories," to be acoustically lined, provide external insulation as specified in paragraph entitled "Duct Insulation Not in Concealed Spaces."

2.2.6 Duct Insulation Finishes

2.2.6.1 All-Purpose Jacket

Provide a factory applied all-purpose jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jackets with a white surface suitable for field painting. All-purpose jacket shall have a maximum water vapor permeance of 0.05 perm per ASTM E 96; a puncture resistance of not less than 50 Beach units; and a tensile strength of not less than 35 pounds-force per inch of width in accordance with ASTM D 828.

2.2.6.2 Vapor-Barrier Material

ASTM C 1136, for duct in equipment room and exposed areas and Type I or II in remaining areas. Material shall be resistant to flame, moisture penetration, and shall not support mold growth. Provide vapor barrier on HVAC duct insulation, except insulation for heating only.

2.2.6.3 Metal Jackets

Provide metal jackets with moisture barrier lining for externally insulated ductwork located outside.

a. Aluminum Jackets: ASTM B 209, Alloy 3003 or 3004, Temper H14, 0.016-, 0.020- inch thick, smooth.

b. Stainless Steel Jackets: ASTM A 167, Type 304, 316, 0.010-, 0.016- inch thick, smooth.

2.3 BOILER STACKS AND BREECHING AND DIESEL ENGINE EXHAUST PIPING INSULATION

ASTM C 592 Class I or ASTM C 612 Class 3 or ASTM C 533, Type I. Insulation and minimum thickness shall comply with Table IV. Fill joints in the block insulation with mineral wool or equivalent insulation cement. For equipment operating at surface temperatures above 600 degrees F, apply block in double layer construction with staggered joints.

2.4 EQUIPMENT

Insulate all equipment and accessories as specified in Table II. In outside locations, provide insulation one inch thicker than specified. Increase the specified insulation thickness for equipment only where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Factory applied insulation shall meet the flame spread and smoke-developed rating of 25/50.

2.5 ADHESIVES, SEALANTS, AND COATING COMPOUNDS

2.5.1 Insulation and Vapor Barrier Adhesive

Provide ASTM C 916, Type I or Type II adhesive for securing insulation to metal surfaces and for vapor barrier lap only in building interior. Provide Type I when an adhesive in which the vehicle is nonflammable in the liquid (wet) state and which will pass the edge-burning test is required. Provide Type II when an adhesive in which the vehicle is nonflammable in the liquid (wet) state and which will not pass the edge-burning test is required.

2.5.2 Lagging Adhesive

MIL-A-3316, Class 1, for bonding fibrous glass cloth to unfaced fibrous glass insulation; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation, or Class 2, for attaching fibrous glass insulation to metal surfaces.

2.5.3 Mineral Fiber Insulation Cement

ASTM C 195, thermal conductivity 0.85 maximum at 200 degrees F mean when tested in accordance with ASTM C 177.

2.5.4 Vapor Barrier Coating

MIL-C-19565, Type II, indoor only above surface temperature 60 degrees F, color white.

2.5.5 Weatherproof Coating

For outside applications provide a weatherproof coating recommended by the manufacturer of the insulation and jackets.

2.5.6 Flexible Unicellular Insulation Adhesive

MIL-A-24179, Type II, Class 1 or Type III.

2.6 ACCESSORY MATERIALS

2.6.1 Staples

ASTM A 167, Type 304 or 316 stainless steel outside-clinch type.

2.6.2 Insulation Bands

1/2 inch wide; 0.24 gage galvanized steel or 0.26 gage stainless steel or 0.24 gage aluminum.

2.6.3 Bands for Metal Jackets

3/8-inch minimum width; 0.26 gage stainless steel or 0.24 gage aluminum.

2.6.4 Anchor Pins

Provide anchor pins and speed washers recommended by insulation manufacturer.

2.6.5 Glass Cloth and Tape

MIL-C-20079, Type I, Class 1 or Class 3 cloth, and Type II, Class 1 or tape; 20 by 20 maximum size mesh. Tape shall be 4-inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be provided.

2.6.6 Wire

Soft annealed stainless steel, 0.047-inch nominal diameter.

2.6.7 PVC Pipe Fitting Cover

FS L-P-535, Composition A, Type II, Grade GU, factory premolded, one-piece.

PART 3 EXECUTION

3.1 PREPARATION

Do not insulate materials until system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Insulate return ducts, outside air intakes and supply ducts to the room outlets, flexible runouts, plenums, casings, mixing boxes, filter boxes, coils, fans, and the portion of air terminals not in the conditioned spaces. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handles, safety reliefs, and other such items. Allow adequate space for pipe expansion. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping and ductwork. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during application of finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:

a. Factory preinsulated flexible ductwork;

b. Vertical portion of interior roof drain pipelines, chrome plated pipes, and fire protection pipes;

c. Vibration isolating connections;

d. Adjacent insulation;

e. ASME stamps;

f. Fan name plates; and

g. Access plates in fan housings.

3.2 PIPING INSULATION

3.2.1 Mineral Fiber Pipe Insulation

Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive factory applied self sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on centers and 1/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1 1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps. Apply staples to both edges of the butt strips. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend the patch not less than 1 1/2 inches past the break in both directions. At penetrations by pressure gages and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior insulation to the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches down beyond the end of the insulation. Seal the flashing and counterflashing underneath with the vapor barrier coating.

3.2.2 Flexible Unicellular Insulation

Bond cuts, butt joints, ends, and longitudinal joints with adhesive, miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral fiber insulation inerts and sheet metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Tape all butt joints with adhesive backed insulation tape. On elastomeric insulation (Rubatex, Armorflex) located outside provide weather covering as follows:

(1) Coat entire surface of insulation with MIL-A-3316

(2) While the adhesive is tacky, apply a layer of MIL-C-20079 glass cloth. Stretch tightly and overlap all joints by a minimum of 2-inches. Glass cloth at elbows and fittings shall be mitered.

(3) Apply a final coat of MIL-A-3316 adhesive.

Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheet-metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Finish all unicellular insulation as follows:

(1) Coat entire surface of insulation with MIL-A-3316

(2) While the adhesive is tacky, apply a layer of MIL-C-20079 glass cloth. Stretch tightly and overlap all joints by a minimum of 2-inches. Glass cloth at elbows and fittings shall be mitered.

(3) Apply a final coat of MIL-A-3316 adhesive.

3.2.3 Calcium Silicate Pipe Insulation

Secure insulation with stainless steel metal bands on 12-inch maximum centers. For high temperature piping (above 600 degrees F); unless single layer insulation is recommended by the manufacturer, apply insulation in two layers with the joints tightly butted and staggered a minimum of 3 inches. Secure the inner layer of insulation with 14-gage soft annealed stainless steel wire on 12-inch maximum centers. The outer layer shall be secured with stainless steel metal bands on 12-inch maximum centers. Apply a skim coat of hydraulic setting cement directly to the insulation. When dry, apply a flooding coat of adhesive over the hydraulic setting cement. Press a layer of MIL-C-20079 glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat cloth with adhesive cut at a ratio of one part water to five parts adhesive in color other than white for the purpose of visual inspection to ensure sizing of entire surface.

3.2.4 Cellular Glass, Cellular Phenolic, and Polyisocyanurate

Secure outer most layer of insulation with metal bands 12-inch on center. If a factory installed all service jacket is used, the metal bands shall be applied to the outside of the all service jacket. If two or more layers are applied, the inner layers may be secured with fiber reinforced tape. For cold or chilled piping all joints both longitudinal and circumferential shall be sealed. Use the manufacturer's recommended cement or sealant. Apply all-purpose jacket, vapor barrier if required by Table I, and metal jacket if outside. Elbows shall be four piece miter if field fabricated. Pre-manufactured elbows can be held in place with metal bands. All elbows shall be finished as follows: Apply a skim coat of hydraulic setting cement directly to the insulation. When dry, apply a flooding coat of adhesive over the hydraulic setting cement. Press a layer of MIL-C-20079 glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat cloth with adhesive cut at a ratio of one part water to five parts adhesive in color other than white for the purpose of visual inspection to ensure sizing of entire surface. Insulate flexible connection at pumps and other equipment with unicellular plastic insulation, unless otherwise indicated. Factory-fabricated removable and reusable insulated covers shall be provided for all valves, circuit setters, unions and flow control devices. The insulation cover shall be reusable without the need for special material or tools. Insulation shall be two piece molded cellular to fit the valve or device. Flexible unicellular insulation may be used in lieu of molded cellular insulation.

3.2.5 Hangers and Anchors

Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide galvanized steel shields protection saddles. Band and secure insulation protection shields without damaging pipe insulation. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass (minimum 8 pcf), molded glass fiber (minimum 8 pcf), or other approved material of the same thickness as adjacent insulation. Inserts shall have sufficient compressive strength to adequately support the pipe without compressing the

inserts to a thickness less than the adjacent insulation. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with vapor barrier coating, Type II or for exterior work, manufacturer's recommended weatherproof coating, as applicable. Where protection saddles are used, fill all voids with the same insulation material as used on the adjacent pipe. Where anchors are secured to chilled piping that is to be insulated, insulate the anchors the same as the piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

3.2.6 Sleeves and Wall Chases

Where penetrating interior walls, extend a metal jacket 2 inches out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.2.7 Flanges, Unions, Valves and Fittings for Hot Piping

Flanges, Unions, Valves, and Fittings Insulation (Except Flexible Unicellular) for Hot Piping: Factory fabricated removable and reusable insulation covers may be used. For inside domestic hot water, heating hot water, A/C condensate drains, high temperature hot water, steam and condensate return systems; exposed hot water piping and drains in handicap areas, place factory premolded, precut or field-fabricated segmented insulation of the same thickness and conductivity as the adjoining pipe insulation around the flange, union, valve, and fitting abutting the adjoining pipe insulation. If nesting size insulation is used, overlap 2 inches or one pipe diameter, whichever is larger. Use insulating cement to fill voids. Elbows insulated using segments shall have not less than three segments per elbow. Place and joint the segments with manufacturer's recommended water-vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Upon completion of installation of insulation, apply two coats lagging adhesive with glass tape embedded between coats. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. The total dry film thickness shall be not less than 1/16 inch. Where unions are indicated not to be insulated, taper the insulation to the union at a 45 degree angle. Coat the insulation and all purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. The total dry film thickness shall be not less than 1/16 inch. At the option of the Contractor, factory premolded one-piece PVC fitting covers may be provided in lieu of two coats of adhesive with tape embedded between coats. Factory premolded field-fabricated segment or blanket insert insulation shall be provided under the fitting covers. Install factory premolded one-piece PVC fitting covers over the insulation and secure by stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not provide PVC fitting covers where exposed to the weather. Provide PVC fitting covers only in ambient temperatures below 150 degrees F.

3.2.8 Piping Exposed to Weather

3.2.8.1 Metal Jackets

Install over the insulation. Metal jackets shall have side and end lap at least 2 inches wide with the cut edge of the side tap turned inside one inch to provide a smooth edge. Overlap the jacket not less than 2 inches at longitudinal and circumferential joints and secure with metal bands at not more than 9-inch centers or with screws at not more than 5-inch centers. Overlap longitudinal joints down to shed water. Seal circumferential joints with a coating recommended by the insulation manufacturer for weatherproofing.

3.2.8.2 Flanges, Unions, Valves, Fittings, and Accessories

Insulate and finish as specified for the applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by the insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than one inch and the adjoining metal jacket not less than 2 inches. Factory preformed metal jackets may be provided in lieu of the above for hot service.

3.3 DUCTS PLENUMS AND CASINGS (HVAC) INSULATION

3.3.1 Rigid Insulation

Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches on centers and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors. Each pin or anchor shall be capable of supporting a 20-pound load. Cut off protruding ends of pins, after clips are sealed with coating compound for inside work or manufacturer's recommended weatherproof coating for outside work, and reinforced with open weave glass membrane.

3.3.2 Flexible Blanket Insulation

Apply insulation with all joints tightly butted. Secure insulation to ductwork with adhesive in 6-inch wide strips on 12-inch centers. Staple laps of jacket with outward clinching staples. Sealing shall be in accordance with paragraph 3.3.3 below. For ductwork over 24 inches on horizontal duct runs, provide pins, washers and clips. Provide pins on sides of vertical ductwork being insulated. Space pins and clips on 18-inch centers and not more than 18 inches from duct corners. Carry insulation over standing seams and trapeze-type hangers. Install speed washers with pins and pin trimmed to washer. Sagging of flexible duct insulation will not be permitted. Cut off protruding ends of pins after clips are secured and sealed with coating compound for inside work. For warm air ducts, overlap insulation not less than 2 inches at joints and secure the laps with outward clinch staples on 4-inch centers. In cold air ducts, vapor seal all joints and staple as specified.

3.3.3 Insulation Finishes and Joint Sealing

Fill all breaks, punctures, and voids with vapor barrier coating compound for inside work or manufacturer's recommended weatherproof coating for

outside service. Vapor seal all joints by embedding a single layer of 3-inch wide open weave glass membrane, 20 by 20 mesh maximum size between two 1/16-inch wet film thickness coats of vapor barrier coating compound. Draw glass fabric smooth and tight with a 1 1/2-inch overlap. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill voids in the insulation with vapor barrier coating. Brush a coat of vapor barrier coating where required on HVAC ducts. Provide vapor barrier jacket continuous across seams, reinforcing, and projections. Where height of projections is greater than insulation thickness, carry insulation and jacket over the projection. For joints for heating only systems, provide insulation with two coats of fire resistant adhesive with glass fabric mesh embedded between coats.

3.3.4 Metal Jackets for Outside Ductwork

Ensure metal-jacket side and end laps at least 2 inches wide, with the cut edge of the side lap turned under one inch to provide a smooth edge. Place horizontal laps to shed water. Seal vertical laps with insulation manufacturer's recommended weatherproof coating. Secure jackets in place with aluminum or stainless steel bands on 9-inch centers aluminum or stainless steel screws on 5-inch centers. Where ducts penetrate exterior walls, continue the increased thickness required for ductwork exposed to weather and the metal jackets through the sleeve to a point 2 inches beyond the interior surface of the wall. Where metal jacket abuts an uninsulated surface, seal joints with a weatherproof mastic recommended by the insulation manufacturer. For rectangular ducts, provide corner angles to exposed corners of the insulation. Apply two coats of weatherproof coating recommended by the insulation manufacturer to the entire surface with a layer of glass cloth embedded between coats. Ensure glass cloth overlaps not less than 2 inches at joints and adjoining surface. Each coat of weatherproof coating shall be 1/16-inch minimum thickness.

3.3.5 Exhaust Duct Insulation

For ovens, griddles, deepfat fryers, steam kettles, vegetable steamers, high pressure cookers, and mobile serving units provide insulation with 3/4-inch wide, minimum 0.15-inch thick galvanized steel bands spaced not over 12 inches on centers; or 16-gage galvanized steel wire with corner clips under the wire; or with heavy welded pins spaced not over 12 inches apart each way. Do not use adhesives.

3.3.6 Access Plates and Doors

On acoustically lined ducts, plenums, and casings, provide insulation on access plates and doors. On externally insulated ducts, plenums, and casings, provide insulation-filled hollow steel panels and doors for access openings. Bevel insulation around access plates and doors.

3.4 BOILER STACKS, BREECHING, AND DIESEL ENGINE EXHAUST INSULATION

3.4.1 Inside Boiler House Mechanical Room

Bevel insulation neatly around openings and provide sheet metal insulation stop strips around such openings. Apply a skim coat of hydraulic setting cement directly to the insulation. Apply a flooding coat of adhesive over the hydraulic setting cement, and while still wet, press a layer of glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat glass cloth with adhesive. When dry, apply a finish coat of adhesive at can-consistency so that when dry no glass weave shall be observed. Provide

metal jackets for stacks, breeching, and exhaust pipes that are located up to 7 feet above finished floor and that pass through occupied spaces outside the boiler house, mechanical room. Apply metal jackets directly over insulation and secure with 3/4-inch wide metal bands spaced on 18-inch centers. Do not insulate name plates.

3.4.2 Outside Boiler House and Room

Insulate smoke breeching between boiler house and room wall and stack as specified above except that in lieu of coating and finish, protect insulation with 24-gage galvanized, stainless steel with raised seams made watertight.

3.5 EQUIPMENT INSULATION

3.5.1 General Procedures

Apply equipment insulation suitable for temperature and service in rigid block or semirigid board or flexible form to fit as closely as possible to equipment. Groove or score insulation where necessary to fit the contours of equipment. Stagger end joints where possible. Bevel the edges of the insulation for cylindrical surfaces to provide tight joints. Join sections of cellular glass insulation with bedding compound. After the cellular glass insulation is in place on areas to be insulated, except where metal-encased, fill joints, seams, chipped edges, or depressions with bedding compound to form a smooth surface. Fill mineral fiber joints with insulating cement. Bevel insulation around name plates, ASME and access plates. For insulation on equipment that must be opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Protect exposed insulation corners with corner angles under wires and bands.

3.5.2 Heating Equipment (Except Pumps)

Insulate shell and tube heat exchangers for the temperature of the shell medium indicated on the drawings. Insulation on heads of heat exchangers shall be removable. Fabricate a male-female shiplap type joint for the removable section. On equipment with ribs such as boiler flue gas connection, draft fans, and fly ash or soot collectors, apply insulation over 6- by 6- by 12-gage welded wire fabric spot welded to the equipment over the ribs. Secure insulation to the fabric with J hooks and 2-by-2 washers or wire loop insulation to the fabric. Use 16-gage galvanized steel, stainless steel, or copper wire or 3/4-inch wide 20-gage stainless steel bands spaced on 12-inch centers. Seal joints with bedding compound for cellular glass or for mineral fiber with insulating cement and cover insulation with a smoothing coat of insulating cement. Apply two coats of adhesive with a layer of glass cloth embedded between coats. The dry film thickness of the finish shall be 1/32-inch minimum. On cylindrical equipment a metal jacket may be provided instead of the adhesive and glass cloths on the cylinder, ends must have adhesive and glass cloth.

3.5.3 Cold Equipment (Except Pumps)

Secure insulation with 16-gage, galvanized steel or copper clad wire or with 3/4-inch wide 20-gage stainless steel bands spaced on 12-inch centers. Seal joints with joint sealer. Cover non-removable irregular surfaces such as corner angles with a smoothing coat of insulating cement. Provide removable heat exchanger head covers with a male-female shiplap type joint. Apply two coats of vapor barrier coating with a layer of glass

cloth embedded between coats. The dry film thickness of the finish shall be 1/32-inch minimum.

3.5.4 Pumps

Insulate pumps used for hot service with 2-inch thick rigid mineral fiber insulation and pumps used for chilled water and brine service with 2-inch thick flexible unicellular sheets as follows: Insulate pumps by forming a box around the pump housing, drive shaft, and piping. Apply insulation to inside surfaces of 20-gage galvanized or stainless steel sheet-metal boxes having openings for drive shaft and pipes. Construct the box by forming the bottom and sides using joints which do not leave raw ends of insulation exposed. Band bottom and sides to form a rigid housing that does not rest on the pump. Between top cover and sides, fit joints tightly forming a female shiplap joint on the side pieces and a male joint on the top cover to make the top cover removable. Secure insulation to the box with adhesive. Allow clearance for draining and adjustment of pump shaft seal.

3.6 PAINTING AND IDENTIFICATION

Paint in accordance with Section 09 90 00, "Paints and Coatings." Piping identification shall be as specified in other sections.

3.7 REPLACEMENT OF EXISTING ASBESTOS INSULATION

Remove existing asbestos insulation in accordance with Section 02 82 16, "Removal and Disposal of Asbestos Materials". When existing asbestos insulation is to be replaced, provide new asbestos-free insulation. Label or stencil new insulation "Asbestos-Free" after final finishing and painting.

3.8 FIELD INSPECTION

Visually inspect to ensure that materials provided conform to specifications. Inspect installations progressively for compliance with requirements.

TABLE I

Piping Insulation Wall Thickness

Service	Material	Tube And Pipe Size (Inches) 1/4-1 1/4	1 1/2-3	3 1/2-5	6-& Larger	Vapor Barrier Required
Brine Systems Cryogenics (Minus 30 to Zero Degrees F)	Cellular Glass	2.5 (3.5)	3.0 (4)	3 (4)	3.5 (4.5)	Yes
	Polyisocyanurate	1.5 (2.0)	1.5 (2)	N.P.(2)	N.P.(2.5)	Yes
Brine Systems, Cryogenics (Zero to 34 Degrees F)	Cellular Glass	2 (3.0)	2 (3.0)	2.5 (3.0)	2.5 (3.0)	Yes
	Polyisocyanurate	1.5 (1.5)	1.5(2.0)	1.5 (2.0)	1.5 (2.0)	Yes
Chilled Water & Dual Temperature & Refrigerant Suction Pipe	Cellular Glass	1.5 (2.0)	1.5 (2.0)	2.0 (2.5)	2.0 (2.5)	Yes
	Polyisocyanurate	1 (1)	1 (1.0)	1.5 (2.0)	1.5 (2.0)	Yes
Domestic Cold Water, Drains and Horizontal Roof Drains	Polyisocyanurate	1	1	1	1	Yes
	Cellular Glass	1.5	1.5	1.5	1.5	Yes
	Cellular Phenolic	1	1	1	1	Yes
Domestic Hot Water	Polyisocyanurate	1	1	1.5	1.5	No
	Calcium Silicate	1.5	1.5	1.5	1.5	No
	Mineral Fiber	1	1	1.5	1.5	No
	Cellular Glass	1.5	1.5	1.5	1.5	No
	Cellular Phenolic	1	1	1	1	No
	Flexible Uni-cellular	1	1	1.5	1.5	No
Heating Hot Water & Pipes (150 to 200 Degrees F)	Polyisocyanurate	1 (1.5)	1 (1.5)	1.5 (2.0)	1.5 (2.0)	No
	Calcium Silicate	1.5 (2.5)	2 (2.5)	2 (2.5)	2.5 (3.0)	No
	Mineral Fiber	1.5 (2.0)	1.5 (2.5)	2 (2.5)	2 (2.5)	No
	Cellular Glass	1.5 (2.5)	1.5 (2.5)	2 (2.5)	2.5 (3.0)	No
	Cellular Phenolic	1 (1.25)	1 (1.25)	1 (1.25)	1.5 1.5)	No
Compressed Air Discharge, Steam, and Condensate (201 to 250 Degrees F)	Calcium Silicate	1.5 (2.5)	2 (2.5)	2 (2.5)	2.5 (3.0)	No
	Mineral Fiber	1.5 (2.0)	1.5 (2.0)	2 (2.5)	2.5 (3.0)	No
	Cellular Glass	1.5 (2.5)	2 (2.5)	2 (2.5)	2.5 (3.0)	No
	Polyisocyanurate	1 (1.5)	1.5 (1.5)	1.5 (2.0)	1.5 (2.0)	No

TABLE I

Piping Insulation Wall Thickness

Service	Material	Tube And Pipe Size (Inches) 1/4-1 1/4	1 1/2-3	3 1/2-5	6-& Larger	Vapor Barrier Required
High Temperature Hot Water and Steam (251 to 350 Degrees F)	Calcium Silicate	2 (3.0)	2.5 (3.5)	2.5 (3.5)	3 (4.0)	No
	Mineral Fiber	2 (3.0)	2.5 (3.5)	2.5 (3.5)	3 (4.0)	No
	Cellular Glass	2.5 (3.5)	3)4.0)	3 (4.0)	4 (5.0)	No
High Temperature Water & Steam (351 to 500 Degrees F)	Calcium Silicate	3 (4.0)	4 (5.0)	4 (5.0)	4 (5.0)	No
	Mineral Fiber	3 (4.0)	4 (5.0)	4 (5.0)	4 (5.0)	No
	Cellular Glass	4 (5.0)	5 (6.0)	5 (6.0)	5 (6.0)	No

NOTE: Thickness in parenthesis are for:

(1) Cold piping - crawl spaces, mechanical rooms, and outside locations

(2) Hot Piping - outside locations, not including tunnels and crawl spaces.

(3) NP - Not permitted.

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TABLE II

Insulation For Equipment

Material	Spec	Type	Class	Vapor Barrier Required
Flexible Mineral Fiber,	ASTM C 553	I	B-3	Yes*/No
Rigid Mineral Fiber,	ASTM C 612		2	Yes*/No
or Cellular Glass	ASTM C 552	I		No

*Yes for chilled water and brine service and no for other services.

Equipment	Recommended Wall Thickness	Vapor Barrier Required
Heat Exchangers	2"	For Chilled Water and Brine Systems
Expansion Tanks	2"	For Chilled Water and Brine Systems
Air Separators	2"	For Chilled Water and Brine Systems
All Pumps	2"	For Chilled Water and Brine Systems
Hot Water Storage Tanks	2"	No
Hot Water Heat Exchangers or Steam to Hot Water Convectors		
Up to 249	2"	No
250 to 400oF	3-1/2"	No
401 to 600oF	6"	No
Hot Water Duct Mounted Coils	2"	No
Drain Pans	2"	For Chilled Water Systems
Pneumatic Water Tanks	2"	For Chilled Water Systems
Water Boxes and Headers	2"	For Chilled Water Systems

*Exact insulation thickness may be determined by proposed condition of use.

TABLE III

Insulation Wall Thickness (Inches)

Service And Surface Temperature Range Degrees F)	Material	Outside Diameter (Inches) 1/4-1-1/4	1-1/2-3	3-1/2-5	6-10	11-36
Boiler Breech and Stack (Up to 400 Degrees F)	Mineral Fiber ASTM C 553 Class B-3, ASTM C 547 Class 1, or ASTM C 612 Class 1	NA	NA	2	2	2
	Calcium Silicate ASTM C 533 Type 1	NA	NA	2	2	2
Boiler Breech and Stack (401 to 600 Degrees F)	Mineral Fiber ASTM C 547, Class 2, ASTM C 592 Class 1, or ASTM C 612 Class 3	NA	NA	3	3	3
	Calcium Silicate ASTM C 533 Type I	NA	NA	3	3	4
Boiler Breech and Stack (601 to 800 Degrees F)	Mineral Fiber ASTM C 547 Class 3,\ ASTM C 592 Class 1, or ASTM C 612 Class 3	NA	NA	4	4	4
	Calcium Silicate ASTM C 533 Type I	NA	NA	4	4	4
Diesel Engine Exhaust	Calcium Silicate ASTM C 533 Type I	6	6	6	6	6

-- End of Section --

SECTION 23 09 54

DIRECT DIGITAL CONTROL SYSTEMS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500	(1991) Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.10	(1997) Electromechanical Watt-hour Meters
ANSI C57.13	(1978; R 1987) Instrument Transformers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 3	(1998) Reducing Emission of Fully Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems

ASME INTERNATIONAL (ASME)

ASME/ANSI B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ANSI B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME/ANSI B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B31.1	(1995) Power Piping
ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC	(2004) Boiler and Pressure Vessel Code with 2005 Supplements, Addenda, and Errata

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995) Gray Iron Castings
ASTM B 32	(1996) Solder Metal
ASTM B 75	(1995; Rev. A) Seamless Copper Tube
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM D 638	(1995) Tensile Properties of Plastics
ASTM D 792	(1991) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 1238	(1995) Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1693	(1995) Environmental Stress-Cracking of Ethylene Plastics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA DCS	(1995; Addendum 1997) HVAC Duct Construction Standards - Metal and Flexible
SMACNA HVACTAB	(1993) HVAC Systems Testing, Adjusting and Balancing

UNDERWRITERS LABORATORIES (UL)

UL 506	(1994; R 1994, Bul. 1994, 1995, and 1996) Specialty Transformers
UL 916	(1994; Bul. 1994 and 1996, R 1996) Energy Management Equipment
UL 1449	(1985; Errata 1986, Bul. 1993, 1994, and 1995) Transient Voltage Surge Suppressors

1.2 RELATED REQUIREMENTS

Section 23 03 00, Basic Mechanical Materials and Methods," applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Digital Controller

A control module which is microprocessor based, programmable by the user,

has integral input/output within the module or on network connected modules, and performs stand-alone operations.

1.3.2 Direct Digital Control (DDC)

Digital controls, as defined in this specification, performing control logic. The controller directly senses building environment and makes control decisions based on user defined, controller resident programs. The controller outputs control signals that directly operate valves, dampers, and motor controllers. No conventional control devices, pneumatic or electronic, such as receiver-controllers, thermostats, and logic units are present within or interface with a direct digital control loop. Actuators are electric or pneumatic, and the controller output is converted to the appropriate type of signal.

1.3.3 DDC System

A system made up of one or more digital controllers which communicate on a network.

1.3.4 Distributed Control

The intent of distributed control is to install the controllers near their respective controlled equipment. The control system consists of stand-alone controllers, with the total number of input and output points limited to 48 or less per controller. Failure of any single controller will not cause the loss of more then 48 control points.

1.3.5 Dynamic Control

A process that optimizes energy efficiency of HVAC systems (air handling units, converters, chillers, and boilers) by increasing and decreasing set points or starting and stopping equipment in response to heating and cooling needs of the facility. A requirement of dynamic control is knowing the heating/cooling demand status of the process. Therefore dynamic control requires controllers connected in a communications network.

1.3.6 Firmware

Firmware is software programmed into read only memory (ROM) and erasable programmable read only memory (EPROM) chips. Software may not be changed without physically altering the chip.

1.3.7 Hand-Held Terminal

A hand-held terminal is a manufacturer specific device connected directly to a communications port on a controller, through which the controller is accessed and, in some cases, programmed.

1.3.8 Input/Output (I/O) Points

I/O points refer to analog inputs (AI), digital inputs (DI), analog outputs (AO), and digital outputs (DO) in a digital controller. Another term for digital inputs and outputs is binary inputs and outputs. Inputs are from analog sensors (temperature, pressure, humidity, flow) and digital sensors (motor status, flow switches, switch position, and pulse output devices). Outputs operate modulating and on/off control devices.

1.3.9 I/O Expansion Unit

An I/O expansion unit provides additional point capacity to a digital controller and communicates with the stand-alone digital controller on a LAN. An I/O unit is not stand-alone because the control program does not reside in the I/O unit. An I/O expander which connects directly to a stand alone controller through a multi-line microprocessor bus is restricted to reside within 3 feet of the stand alone controller and is considered part of the stand alone controller.

1.3.10 Local Area Network (LAN)

a. A communications bus that interconnects digital controllers for peer-to-peer (see "peer-to-peer" below) communications. Different levels of LANs are possible within a single DDC system. In this case, a digital controller on a higher level LAN acts as a network controller to the controllers on the lower level LAN. The network controller, then, has at least two LAN communications ports. One port supports peer-to-peer communications with other digital controllers on the higher level LAN. The other port supports communications with the digital controllers on the lower level LAN.

b. LANs permit sharing global information. This allows building and site wide control strategies such as peak demand limiting, dynamic control strategies, coordinated response to alarm conditions, and remote monitoring and programming of digital controllers.

1.3.11 Microprocessor

A microprocessor refers to the central processing unit (CPU) that contains all registers and logic circuitry that allow digital controllers to function.

1.3.12 Output Signal Conversion

Output signal conversion refers to changing one kind of control output into a proportionally related signal appropriate for direct actuation of the controlled device. An example is converting a 4 to 20 mA or 0 to 10 VDC signal to a proportional 3 to 15 psig signal to operate a pneumatic actuator.

1.3.13 Optimum Start

Optimum start is a method of starting HVAC equipment prior to scheduled occupancy in order to have the building at set point when occupied. Optimum start is based on the zone temperatures, zone set points, and outdoor temperature.

1.3.14 Peer-to-Peer

Peer-to-peer refers to controllers connected on a communications LAN that act independently, as equals, and communicate with each other to pass information.

1.3.15 PID

PID refers to proportional, integral, and derivative control; the three types of action that are used in controlling modulating equipment.

1.3.16 Resolution

Refers to the number of possible states an input value or output value can take and is a function of the digital controller I/O circuitry; the A/D converter for input and the D/A converter for output. Ten bit resolution has 1024 possible states.

1.3.17 Stand-Alone Control

Refers to the digital controller performing required climate control, and energy management functions without connection to another digital controller or computer. Requirements for stand-alone control are a time clock, a microprocessor, resident control programs, PID control, and I/O. All stand-alone controllers have a communication port and firmware for direct connection and interrogation with a laptop computer or similar hand-held device. This interrogation includes parameter changes and program downloads.

1.3.18 Site Building Controller (SBC)

The SBC is an interface controller between the "Sitenet" central server and the DDC system installed in the building. Unless otherwise specified there is one SBC located in each building.

1.3.19 SiteNet

SiteNet is the centrally located intranet based Energy Management and Control System installed at Camp Lejeune. It consists of two computer servers (labeled "SiteNet-EA" and "SiteNet DB") located in Building 1202. The "SiteNet-EA" Server communicates over the Camp Lejeune Intranet with the Site Building Controllers located in each building on the system. SiteNet provides access to DDC input/output devices, floor plans, and mechancial system graphics via the Camp Lejeune intranet and through a standard web browser.

1.3.20 Terminal Control Unit (TCU)

An off-the-shelf, stand-alone digital controller equipped for communication on a lower level LAN. TCUs may deviate from stand-alone only in receiving energy management and time information from a stand alone digital controller. A TCU is commonly application specific and is used for distributed control of specific HVAC subsystems. A TCU communicates with other digital controllers. Typically, a TCU communicates on a lower level LAN. Examples where TCUs are used include small air handling units (AHUs), variable air volume (VAV) boxes, fan coil units, and heat pumps.

1.3.21 Workstation

The workstation is a computer with installed software to provide an interface for monitoring, troubleshooting, and making adjustments to the program or operating parameters of all DDC controllers, including TCU's.

1.4 DDC SYSTEM DESCRIPTION

a. Remove existing and provide new and modify existing DDC systems including associated equipment and accessories. Manufacturer's products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in

accordance with ASME B31.1 and NFPA 70, except as modified herein or indicated otherwise.

b. Provide the DDC systems to maintain stable temperature control and all other conditions as indicated. The end-to-end accuracy of the system, including temperature sensor error, wiring error, A/D conversion, and display, shall be 1 degree F or less.

c. The existing DDC system was manufactured by _____.

d. Provide a DDC system with a new workstation and workstation software. If working with an existing DDC system of the same manufacturer, upgrade the existing workstation software with the manufacturers' latest software version.

1.4.1 Design Requirements

1.4.1.1 Control System Schematic

Provide control system schematic that includes the following:

a. Location of each input and output device

b. Flow diagram of each HVAC component, for instance flow through coils, fans, dampers

c. Name or symbol for each component such as V-1, DM-2, and T-1 for a valve, damper motor, and temperature sensor, respectively

d. Set points

e. Sensor range

f. Actuator range

g. Valve and damper schedules and normal position

h. Switch points on input switches

i. Written sequence of operation for each schematic

j. Schedule identifying each sensor and controlled device with the following information:

(1) LAN and Software point name with send and receive address if applicable

(2) Point type (AO, AI, DO, DI)

(3) Point range

(4) Digital controller number for each point

1.4.1.2 Electrical Equipment Ladder Diagrams

Submit diagrams showing electrical equipment interlocks, including voltages and currents.

1.4.1.3 Component Wiring Diagrams

Submit a wiring diagram for each type of input device and each type of output device. Diagram shall show how the device is wired and powered; showing typical connections at the digital controller and each power supply, as well as at the device itself. Show for all field connected devices, including, but not limited to, control relays, motor starters, electric or electronic actuators, and temperature, pressure, flow, proof, and humidity sensors and transmitters.

1.4.1.4 Terminal Strip Diagrams

Submit a diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.

1.4.1.5 Communication Architecture Schematic

Submit a schematic showing communication networks used for all DDC system controllers, workstations, and field interface devices.

1.5 SUBMITTALS

Submit manufacturers' specification sheets for each type of equipment to show compliance with the project specification. For each type of equipment highlight each compliance item and reference each item to the relevant specification paragraph number. Submit sufficient manufacturers' information to allow verification of compliance by the reviewing authority. Equipment and software for which specification compliance data shall be submitted includes but is not limited to the following:

SD-02 Shop Drawings

List of Symbols and Abbreviations Used on Drawings

List of I/O Points

Equipment Components List

AC Power Table

Control system schematic

Ladder diagrams

Component wiring diagrams

Terminal strip diagrams

Communication architecture schematic

After initial submittal and approval, submit the following:

Drawing of operating program in the un-compiled form

Copy of the graphic pages of the operating interface program

SD-03 Product Data

DDC hardware

DDC capabilities

Variable frequency drive hardware

Workstation software

Input devices

Output devices

Surge and transient protection

Laptop computer

Hand-held terminal

Smoke detectors

Pneumatic tubing

SD-06 Test Reports

Field tests

Performance verification tests

SD-07 Certificates

Contractors Qualifications

Training

Pressure Tank Certification

SD-10 Operation and Maintenance Data

Controls and HVAC System Operators Manual

DDC Manufacturer's Hardware and Software Manuals

SD-11 Closeout Submittals

Posted operating instructions:

Air compressors

Refrigerated air dryer

Provide administrative and closeout submittals:

Training course documentation

Service organizations

Contractor certification

1.6 OPERATING ENVIRONMENT

Protect components from humidity and temperature variations, dust, and other contaminants, within limits published by the manufacturer.

1.7 QUALITY ASSURANCE

1.7.1 Standard Products

a. Material and equipment shall be standard products of manufacturer regularly engaged in the manufacturing of such product, using similar materials, design and workmanship. The standard products shall have been in commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of similarly sized equipment and materials used under similar circumstances and sold on the commercial market through advertisements, manufacturers' catalogs, or brochures.

b. Products are supported by a local service organization.

1.7.1.1 DDC Hardware

a. I/O type and characteristics

b. Resident programs

c. Communications ports

d. Protected memory

e. Operating temperature limits

1.7.1.2 DDC Capabilities

a. Communications; baud rates, communication ports, hierarchy

b. Trending capabilities

c. Alarming capabilities; capable of alarm generation as defined in this specification

d. Messaging capabilities

e. Self diagnostic capabilities

e. PID control capabilities

1.7.1.3 Workstation Software

a. Mouse and keyboard operation

b. Communications

c. DDC Program download capability

d. Dynamic point update

e. Program modification

f. Database modification

g. Graphics and graphics modification

h. Penetration of graphics

1.7.1.4 Input Devices

a. Transmitters

b. Temperature sensors

c. Humidity sensors

d. Pressure sensors

e. Flow or motor proof

f. Sensor wells

1.7.1.5 Output Devices

a. Dampers

b. Valves

c. Actuators

d. Control relays

e. Solenoid air valves

f. Electronic to pneumatic transducer

1.7.1.6 Surge and Transient Protection

a. Power line

b. Communications lines

c. Controller I/O

1.7.2 Nameplates and Tags

a. Nameplates and tags bearing device unique identifiers shall be engraved or stamped. Permanently attach nameplates to HVAC control panel doors and back plates.

b. For each field mounted piece of equipment attach a plastic or metal tag with equipment name and point identifier.

1.7.3 Verification of Dimensions

The contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing work.

1.7.4 Drawings

Because of the small scale of the drawings, it is not possible to indicate

all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work, and shall furnish all work necessary to meet such conditions.

1.7.4.1 List of Drawings

Provide a list of drawings.

1.7.4.2 List of Symbols and Abbreviations Used on Drawings

Provide an index of symbols and abbreviations used on the drawings.

1.7.4.3 List of I/O Points

For each input and output physically connected to a digital controller provide, on a controller by controller basis, provide the following:

a. Point description: for example: mixed air temperature, supply fan start/stop, etc.

b. Point type: AO, AI, DO, or DI.

c. Point range

d. Sensor range associated with point range:

e. Software name(s) associated with point, if any.

f. Point connection terminal number

1.7.4.4 Equipment Components List

Submit a listing of controllers and connected devices shown on control system schematic. List the following:

a. Control system schematic name

b. Description

c. Manufacturer of controller

d. Controller's name

e. Equipment part numbers

f. Cv for valves

g. For actuators:

(1) Motive force (such as pneumatic, or electric)

(2) Normal position

(3) Nominal operating range (such as 3 to 7 psi, 4 to 8 mA)

1.7.4.5 AC Power Table

Submit a table listing each controller and the circuit breaker number,

panel box number, and physical location of each controller's source of AC power.

1.7.5 Contractors Qualifications

a. The Contractor or subcontractor performing the work shall have completed at least three DDC systems installations of a similar design and have successfully operated a similar sequence of operation for at least three years.

1.7.6 Pressure Tank Certification

Provide certification stating pressure tanks are constructed and labeled in accordance with ASME BPVC SEC VIII for a minimum of 125 psig working pressure.

1.7.7 Training Course Documentation

Training course documentation shall include a manual for each trainee plus two additional copies and two copies of audiovisual training aids, if used. Documentation shall include an agenda, defined objectives for each lesson and detailed description of the subject matter of each lesson.

1.7.8 Service Organizations

Qualified service organization list that shall include the names and telephone numbers of organizations qualified to service the HVAC control systems.

1.7.9 Contractor Certification

Provide certification that the installation of the control system is complete and meets the technical requirements of this section.

1.7.10 Controls and HVAC System Operators Manual

Provide two copies of a Control and HVAC Systems Operators Manual. Provide in a 3 ring binder with a minimum of the following 7 sections. Use tabs to divide each section.

a. Description of HVAC Systems: Provide a description of the HVAC system components and control system. Include sequence of operation and a complete points list.

b. Controls Drawings: Provide drawings as specified in submittal paragraph.

c. Control Program Listings: Provide listing of all control programs, including terminal equipment controller setup pages if used.

d. Current Operating Parameters: Provide printouts of input and output setup information, (database setups). This section provides information such as point addresses, slopes and offsets for all points, database of points, etc.

e. Design Information: Provide tab, but leave this section blank.

f. Control Equipment Technical Data Sheets: Provide technical data

sheets for all controller hardware and accessories.

1.7.11 Software delivered to the Owner

In addition to software loaded into the controllers provide on separate CDs and loaded into the laptop workstation:

a) One registered copy of all software used to program control sequences in direct digital controllers, LAN controllers and field configurable smart controllers.

b) One un-compiled copy in editable format of the final version of all operating software installed on all direct digital controllers.

c) One compiled copy of the final version of all operating software installed on all direct digital controllers.

Additionally:

d) Where specially programmed factory configured smart controllers are used in the system, provide the minimum factory programming tools and specialized controller programs ready for download to replacement controllers.

Provide any access keys which restrict programming language software functions or the ability to compile or prepare programming for download to controllers.

1.7.12 DDC Manufacturer's Hardware and Software Manuals

Provide the following manuals.

a. Installation and Technical Manuals for all digital controller hardware.

b. Installation and Technical Manuals for workstation.

c. Operator Manuals for all digital controllers.

d. Operator Manuals for all workstation software.

e. Programming Manuals for all digital controllers.

f. Programming Manuals for workstation software.

1.7.13 Modification of References

The advisory provision in ASME B31.1 and NFPA 70 are mandatory. Substitute the word "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 DDC SYSTEM

a. Provide a DDC system as a distributed control system. The system shall have stand-alone digital controllers, a communications Network, and a separate workstation computer with workstation

software.

b. Provide an operator programmable system to perform closed-loop, modulating control of building equipment. Connect all digital controllers through the communication network to share common data and report to workstation computers. Provide workstation DDC software capable of programming and monitoring the digital controllers. The control system shall be capable of downloading programs between the workstation and digital controllers.

c. Provide the quantity of digital controllers indicated on the drawings to perform required climate control, energy management, and alarm functions. The quantity of controllers shall be no less than the number shown on drawings. All material used shall be currently in production.

2.1.1 Direct Digital Controllers

DDC hardware shall be UL 916 rated.

2.1.2 Distributed Control

Apply digital controllers in a distributed control manner.

2.1.3 I/O Point Limitation

Total number of I/O hardware points, including those communicated over a LAN, used by a single stand-alone digital controller, including I/O expansion units shall not exceed 48.

2.1.4 Environmental Operating Limits

Provide digital controllers that operate in environmental conditions between 32 and 120 degrees F.

2.1.5 Stand-Alone Control

Provide stand-alone digital controllers.

2.1.6 Internal Clock

Provide a clock with each stand-alone controller. Each controller shall have its clock backed up by a battery or capacitor with sufficient capacity to maintain clock operation for a minimum of 72 hours during power outage.

2.1.7 Memory

a. Provide sufficient memory for each controller to support required control, communication, trends, alarms, and messages

b. Memory Protection: Programs residing in memory shall be protected either by using EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply (UPS)). The backup power source shall have sufficient capacity to maintain volatile memory during an AC power failure. Where the uninterruptible power source is rechargeable (a rechargeable battery), provide sufficient back-up capacity for a minimum of seventy-two hours. The rechargeable power source shall be constantly charged while the controller is operating under normal

line power. Where a non-rechargeable power source is used, provide sufficient capacity for a minimum of two years accumulated power failure. Batteries shall be replaceable without soldering.

2.1.8 Inputs

Provide input function integral to the direct digital controller. Provide input type(s) as required by the DDC design. For each type of input used on high-level controllers, provide at least one similar spare input point per controller.

a. Analog Inputs: Allowable input types are 100 ohm (or higher) platinum RTDs, thermistors, 4 to 20 mA, and 0-10 VDC. Thermistor and direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall have 10-bit minimum resolution.

b. Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications.

2.1.9 Outputs

Provide output function integral to the direct digital controller. Provide output type(s) as required by the DDC design. For each type of output used on high-level controllers, provide at least one similar spare output point per controller.

a. Analog Outputs: Provide controllers with a minimum output resolution of 10 bits. Output shall be 4 to 20 mA, 0 to 10 VDC, or 0 to 20 psig. Each pneumatic output shall have feedback for monitoring of the actual pneumatic signal.

b. Digital Outputs: Provide contact closure with contacts rated at a minimum of 1 ampere at 24 volts.

2.1.10 PID Control

Provide controllers with proportional, integral, and derivative control capability. Terminal controllers are not required to have the derivative component.

2.1.11 Digital Controller Networking Capabilities

The upper level digital controllers shall be capable of networking with other similar upper level controllers. Upper level controllers shall also be capable of communicating to the Site Building Controller.

2.1.12 Communications Ports

a. Controller-to-Controller LAN Communications Ports: Controllers in the building DDC system shall be connected in a communications network. Controllers shall have controller to controller communication ports to both peer controller (upper level controllers) and terminal controllers (lower level controllers). Network may consist of more than one level of local area network and each level may have multiple drops. Communications network shall permit sharing information between controllers, allowing execution of dynamic control strategies, and coordinated response to alarm conditions. Minimum baud rate for the lowest level LAN

shall be 9600 Baud. Minimum baud rate for the highest level LAN shall be 9600 Baud. Minimum baud rate for a DDC system consisting of a single LAN shall be 9600 Baud.

b. On-Site Interface Ports:

(1) All Controllers: Provide a RS-232, RS-485, USB, or RJ-11(Lon/Bacnet) communications port for each digital controller that allows direct connection of a computer or hand held terminal and through which the controller may be fully accessed. Controller access shall not be limited to access through another controller. On-site interface communication ports shall be in addition to the communications port(s) supporting controller to controller communications. Communication rate shall be 9600-Baud minimum.

(2) highest Level LAN: Every controller on the highest level LAN shall have a communications port supporting direct connection of the workstation computer; a hand held terminal port is not sufficient. By connecting the workstation computer to this port, every controller in the direct digital control system shall be able to be fully accessed and programmed. The following operations shall be available: downloading and uploading control programs, modifying programs and program data base, modifying set points, and retrieving or accepting trend reports, status reports, messages, and alarms.

c. SiteNet Interface Port: Provide one additional communications port in each DDC system permitting remote communications via the Site Building controller.

2.1.13 Digital Controller Cabinet

Each indoor digital controller cabinet shall protect the controller from dust and shall be rated NEMA 1, unless specified otherwise. Each outdoor digital controller cabinet shall protect the controller from all outside conditions and shall be rated NEMA 4. Cabinets for high level controllers shall be hinged door, lockable, and have offset removable metal back plate.

2.1.14 Main Power Switch

Each controller on the highest level LAN or each control cabinet shall have a main external power switch for isolation of the controller from AC power. The switch shall be located in the DDC cabinet.

2.1.15 Site Building Controller (SBC)

Provide a Site Building Controller. The SBC shall be a JACE 512, manufactured by Tridium. Provide all necessary drivers to communicate between SBC and provided DDC upper level controller.

2.2 TERMINAL CONTROL UNITS

a. The same company as the digital controllers shall manufacture TCUs.

b. TCUs shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a digital controller on a higher

level LAN.

c. TCUs do not require an internal clock, if they get time information from a higher level digital controller.

2.3 DDC SOFTWARE

2.3.1 Programming Software

All controllers except TCU's shall be programmable. The operating software shall be created using a windows based drag and drop graphical programming software. TCU's may have permanently installed un-modifiable programs with modifiable parameters.

2.3.2 Sequence of Control

Provide, in the digital controllers, software to execute the sequence of control. At minimum, controllers must be capable of performing programming functions outlined in the following "Parameter Modification" section.

2.3.2.1 Parameter Modification

Provide software to modify control parameters. Parameter modification shall be accomplished for all controllers (high level and low level application specific) through the laptop workstation computer or keypad terminal directly at each controller. Modifications shall be accomplished without having to make changes directly in un-compiled programming. Database parameters in the following list that take real number values shall require assignment of variable names so parameters can be changed without modifying programming. Alternatively, block programming languages shall provide for modification of these database parameters in fill-in-the-blank screens. Parameters of like type, including those in different high level and low level controllers, may be grouped together for a single, global change. For example, an operator may group all second floor space temperature set points into a group and raise the set point by two degrees with a single command. The following parameters shall be modifiable in this way:

a. Set points

b. Dead band limits and spans

c. Reset schedules

d. Switchover points

e. PID gains and time between control output changes

f. Time

g. Timed local override time

h. Occupancy schedules

i. Holidays

j. Alarm points, alarm limits, and alarm messages

k. Point definition database

l. Point enable, disable, and override

m. Trend points, trend intervals, trend reports

n. Analog input default values

o. Passwords

p. Communications parameters including network and telephone communications setups

2.3.2.2 Differential

Where set point is in response to some analog input such as temperature, pressure, or humidity, include a set point differential for the control loop to prevent short cycling of control devices.

2.3.3 Motor and Flow Status Delay

Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful command execution.

22.3.4 Runtime Accumulation

Provide re-settable run time accumulation for each controlled digital output.

2.3.5 Timed Local Override

Provide user definable adjustable run time for each push of a momentary contact timed local override. Pushes shall be cumulative, reset clock with each push designating the same length of time. Provide a user definable limit on the number of contact closures summed, such as 6, before the contact closures are ignored. Timed local overrides are disabled during occupancy periods.

2.3.6 Time Programs

Provide programs to automatically adjust for leap years, and make daylight savings time and standard time adjustments.

2.3.7 Scheduling

a. Individual controlled equipment shall be schedulable with schedule based on time of day, day of week, and day of year. Equipment may be associated into groups. Each group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of all equipment in the group. Groups may be modified, created and deleted by the operator.

b. Provide capability that will allow current schedules to be viewed and modified in a seven-day week format. When control program does not automatically compute holidays, provide capability to enter holiday schedules one full year at a time.

2.3.8 Point Override

I/O and virtual points shall accept software overrides to any possible value.

2.3.9 Alarming

I/O points and software points shall be alarmable. Alarms may be enabled and disabled for every point. Alarm limits shall be adjustable on analog points. Controllers connected to an external communications device such as a printer, terminal, or computer, shall download alarm and alarm message when alarm occurs. When a computer workstation is connected to a DDC system with a modem, operator selected alarm conditions will initiate a call and report to the computer or an alphanumeric pager. Otherwise alarms will be stored and automatically downloaded when a communications link occurs. The following conditions shall generate alarms:

a. Motor is commanded on or off but the motor status input indicates no change

b. Temperature, humidity, or pressure strays outside selectable limits

c. An analog input takes a value indicating sensor failure

d. A module is not communicating on the LAN

e. A power outage occurs

2.3.10 Messages

Messages shall be operator defined and assigned to alarm or status conditions. Messages shall be displayed on the workstation or printer when these conditions occur.

2.3.11 Trending

DDC system shall have the capability to trend all I/O and virtual points. Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from one minute to 60 minutes at a minimum The minimum number of consecutive trend values stored at one time shall be 30 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to computer. Trend data shall be available on a real time basis; trend data shall appear numerically and graphically on a connected computer's screen as the data is processed from the DDC system. Trend reports shall be capable of uploading to computer for storage.

2.3.12 Status Display

Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and virtual points associated with control of a single air handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as AHU-4, Second Floor, Chiller System, and other such names.

2.3.13 Diagnostics

Each controller shall perform self-diagnostic routines and provide messages to an operator when errors are detected. The DDC system shall be capable of recognizing a non-responsive module on a LAN. The remaining, responsive modules on a LAN shall not operate in a degraded mode.

2.3.14 Power Loss

During a power outage, each controller shall assume a disabled status and outputs shall go to a user definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs.

2.3.15 Program Transfer

Provide software for download of control programs and database from a computer to controllers and upload of same to computer from controllers. Every digital controller in the DDC system shall be capable of being downloaded and uploaded to through a single controller on the highest level LAN.

2.3.16 Password Protection

Provide at least three levels of password protection to the DDC system permitting different levels of access to the system. The lowest level allows monitoring only. The highest level allows full control of all functions, including setting new passwords.

2.3.17 Network Variable Instance Chart

The "Network Variable Instance Chart" is a graphical listing of all the points and how they are seen electronically by their respective networks. The two Network Variable Instance Charts below are examples of the type of information required for each point. The first chart is for the Bacnet Protocol. The second chart is for the LonWorks protocol (SNVT).

POINT NAME	POINT DESCRIPTION	Object Type	Instance	BacNet Network
BAC ChillWtrSYS	Chilled Water System Controller	Device	1000	95
BAC CrsOvrLpFlw	Cross Over Loop Chill Wtr Flow	Analog Input	1001	95
BAC CrsOvrLpTmp	Cross Over Loop Chill Wt Temp	Analog Input	1002	95
BAC CT1Amps	Cooling Tower #1 Amps	Analog Input	1003	95
BAC CT2Amps	Cooling Tower #2 Amps	Analog Input	1004	95
BAC CT3Amps	Cooling Tower #3 Amps	Analog Input	1005	95
BAC FL1.DA11	Flr1 Zone #11 Discharge Air T	Analog Input	1006	95

POINT NAME	POINT DESCRIPTION	Object Type	Instance	BacNet Network
BAC FL1.DA12	Flr1 Zone #12 Discharge Air T	Analog Input	1007	95
BAC FL1.DA2	Flr1 Zone #02 Discharge Air T	Analog Input	1008	95
BAC L1.DA3	Flr1 Zone #03 Discharge Air T	Analog Input	1009	95
BAC LL1.RA	Lower Lev1 Return Air Temp	Analog Input	1010	95
BAC LL1.RHUM	Lower Lev1 Ret Air Humidity	Analog Input	1011	95
BAC LL1.RS	Lower Lev1 Ret Static Pressure	Analog Input	1012	95
BAC LL1RLOAD	Lower Lev1 Return Fan Amps	Analog Input	1013	95
BAC LL1SLOAD	Lower Lev1 Supply Fan Amps	Analog Input	1014	95
BAC LL2.CO2	Lower Lev2 CO2 Sensor	Analog Input	1015	95
BAC LL2.DA	Lower Lev2 Supply Air Temp	Analog Input	1016	95
BAC OCCMD	Chilled water System Enable	Binary Output	1017	95
BAC CHWSSP	Chilled Water Supply Setpoint	Analog Output	1018	95
BAC CDWDiffPrs	Condenser Loop Diff Pressure	Analog Input	1019	95

SNVT NAME	POINT DESCRIPTION	SNVT TYPE
NviSetPoint	Space Setpoint	SNVT temp p
NvoHeatOutput	Heat Output Percent	SNVT lev percent
NvoCoolOutput	Cool Output Percent	SNVT lev percent
NvoFanSpeed	Fan Speed Position	SNVT switch
NviOccCmd	Occupied Command	SNVT occupancy
NviApplicMode	HVAC Mode	SNVT hvac mode
NvoSetpointOffset	Setpoint Offset	SNVT temp p
NvoDischAirTemp	Discharge Air Temperature	SNVT temp p
NvoSpaceTemp	Space Temperature	SNVT temp p
NvoEffectSetpt	Effective Setpoint	SNVT temp p
NvoOccCmd	Occupied Command Feedback	SNVT occupancy
NvoUnitStatus	Unit Run Status	SNVT hvac status

The following chart is a listing of all points required on this project. Provide the Network Variable Instance Chart in the appropriate format for this project. Make all of these point available to SiteNet. Ensure proper communications between the DDC system installed and the Site Building Controller.

POINT DESCRIPTION	Object Type
Chilled Water System Controller	Device
Cross Over Loop Chill Wtr Flow	Analog Input
Cross Over Loop Chill Wt Temp	Analog Input
Cooling Tower #1 Amps	Analog Input
Cooling Tower #2 Amps	Analog Input
Cooling Tower #3 Amps	Analog Input
Flr1 Zone #11 Discharge Air T	Analog Input
Flr1 Zone #12 Discharge Air T	Analog Input
Flr1 Zone #02 Discharge Air T	Analog Input
Flr1 Zone #03 Discharge Air T	Analog Input
Lower Lev1 Return Air Temp	Analog Input
Lower Lev1 Ret Air Humidity	Analog Input
Lower Lev1 Ret Static Pressure	Analog Input
Lower Lev1 Return Fan Amps	Analog Input
Lower Lev1 Supply Fan Amps	Analog Input
Lower Lev2 CO2 Sensor	Analog Input
Lower Lev2 Supply Air Temp	Analog Input
Chilled water System Enable	Binary Output
Chilled Water Supply Setpoint	Analog Output
Condenser Loop Diff Pressure	Analog Input

2.4 Workstation

a. Provide a workstation computer with installed software to provide an interface for monitoring, troubleshooting, and making adjustments to the program or operating parameters of all DDC controllers, including TCUs. The workstation shall also be capable of programming all controllers, including TCUs.

b. DDC system shall routinely operate continuously without connection to the workstation. Information at the workstation is not required for day to day operations of the direct digital controllers.

2.4.1 Hardware

a. Provide laptop computer, necessary software, and direct connection cable to communicate with all digital controllers and smart thermostats when directly connected.

b. Provide laptop computer with the following features as a minimum:

(1) _____ GHz with active matrix color screen

(2) Internal hard disk; minimum ___Gigabytes

(3) Internal battery operation; for a minimum of 3 hours of

operation.

(4) RAM; minimum ___ Megabytes

(5) ___X CD ROM and 3.5 inch 1.44 MB floppy drive

(6) Interface port to communicate with the digital controller. Parallel port to communicate with a printer.

2.4.2 Software

Workstation software shall be recommended and supported by the DDC system manufacturer and configured to operate according to the DDC system manufacturer's specifications. Software shall be resident in the workstation computer and permit monitoring and troubleshooting of the DDC system. Workstation software permits modification of controller parameters and control for all controllers, both high level and low level application specific. Operations shall be menu selected. Menu selections shall be made with a mouse.

a. Menu System: Menu system shall allow an operator to select a particular function or access a particular screen through successive menu penetration.

b. Controller Parameter Modification: The workstation software shall be an interface for performance specified in paragraph entitled "Parameter Modification" and available through direct connection of a computer to a digital controller. Parameter modification shall require only that an operator "fill in the blank" for a parameter on a screen requesting the information in plain language. Parameter modifications shall download to the appropriate controllers at operator request.

c. Program modification: For systems using block programming languages provide a capability for linking blocks together to create new programs or modify existing programs. Program modifications shall download to appropriate controllers at operator request.

d. Trending: Trend data shall be displayed graphically, with control variable and process variable plotted as functions of time on the same chart. Graphic display of trend data shall be internal to the workstation software and not resulting from download of trend data into a third-party spreadsheet program such as Excel, unless such transfer is automatic and transparent to the operator, and the third-party software is included with the workstation software package. At the operator's discretion, trend data shall be plotted real time.

2.5 Maintenance Personnel Interface Tools

Provide a handheld terminal if required to communicate directly with the Terminal control Units(TCU). If the workstation laptop is not capable, or is not set up to communicate with TCUs except through the DDC LAN, a handheld terminal is required.

2.6 SENSORS AND INPUT HARDWARE

2.6.1 Field Installed Temperature Sensors and Transmitters

2.6.1.1 Thermistors

Precision thermistors may be used in temperature sensing applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between the range of 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degree F cumulative. Sensor element and leads shall be encapsulated. Bead thermistors are not allowed. A/D conversion resolution error shall be kept to 0.1 degree F. Total error for a thermistor circuit shall not exceed 0.5 degree F, which includes sensor error and digital controller A/D conversion resolution error. Provide 18 gage twisted and shielded cable for thermistors.

2.6.1.2 Resistance Temperature Detectors (RTDs)

Provide RTD sensors with 1000 ohm, or higher, platinum elements that are compatible with the digital controllers. Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degree F cumulative. Direct connection of RTDs to digital controllers, without transmitters, is preferred provided controller supports direct connection of RTDs. When RTDs are connected directly to the controller, keep lead resistance error to 0.25 degree F or less. Total error for a RTD circuit shall not exceed 0.5 degree F, which includes sensor error, lead resistance error or 4 to 20 mA or 0 to 10 VDC transmitter error, and A/D conversion resolution error.

2.6.1.3 Temperature Sensor Details

a. Room Type: Conceal element behind protective cover matched to the room interior. Room temperature sensors connected directly to application specific controllers shall have integral pushbutton, system override digital input button, and a setpoint adjustment lever

b. Duct Averaging Type: Continuous averaging RTDs for ductwork applications shall be one foot in length for each 4 square feet of ductwork cross-sectional area with a minimum length of 6 feet. Probe type duct sensors of one foot length minimum are acceptable in ducts 12 feet square and less.

c. Immersion Type: Three inches total immersion for use with sensor wells, unless otherwise indicated.

d. Sensor Wells: Stainless steel brass material. Provide heat-sensitive transfer agent between exterior sensor surface and interior well surface.

e. Outside Air Type: Provide element on the buildings north side with sunshade to minimize solar effects. Mount element at least 3 inches from building outside wall. Sunshade shall not inhibit the flow of ambient air across the sensing element. Shade shall protect sensing element from snow, ice, and rain.

2.6.1.4 Temperature Transmitters

Transmitters shall have 4 to 20 mA or 0 to 10 VDC output linearly scaled to the temperature sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 24 volts ac or dc. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter stability shall not exceed 0.05 degrees C a year.

2.6.1.1 Temperature Transmitter Spans and Ranges

Transmitter spans or ranges shall meet the following:

a. Temperature:

(1) 50 degrees F span: Room, chilled water, cooling coil discharge air, return air sensors

(2) 100 degrees F span: Outside air, hot water, heating coil discharge air, mixed air sensors

(3) 200 degrees F span: High temperature hot water, heating hot water, chilled/hot water system sensors.

2.6.2 Relative Humidity Transmitters

Provide integral humidity transducer and transmitter. Output of relative humidity instrument shall be a 4 to 20 mA or 0 to 10 VDC signal proportional to full range of relative humidity input. Accuracy shall be 2 percent of full scale, long-term stability shall be less than one percent drift per year. Range shall be 10 to 90 percent minimum relative humidity. Sensing element shall be polymer or thin film polymer type.

2.6.3 Pressure Transmitters

Provide integral pressure transducer and transmitter. Output of pressure instrument shall be a 4 to 20 mA signal proportional to the pressure span. Accuracy shall be 1.0 percent. Linearity shall be 0.1 percent. Span shall be as follows:

(1) -0.5 to 0.5 -0.25 to 0.25 inches water differential range: static pressure control of rooms

(2) 0 to 5 inches water differential range: Duct static pressure

(3) 0 to 60 psig 0 to 100 psig, 0 to 200 psig differential: Water differential pressure

2.6.4 Current Transducers

Provide current transducers to monitor amperage of motors. Select current transducer for normal measured amperage to be near 50 percent of full-scale range. Current transducers shall have an accuracy of one percent and 4 to 20 mA or 0 to 10 VDC output signal.

2.6.5 Air Quality Sensors

2.6.5.1 CO2 Sensor

Provide CO2 sensors with integral transducers where shown. Output signal shall be 4 to 20 mA or 0 to 10 VDC. Accuracy shall be +5 percent of full scale.

2.6.5.2 Air Quality Sensor

Provide full spectrum air quality sensors with filters utilizing hot wire element based on the Taguchi principle. The sensor monitors a wide range of gaseous organic materials which are common components of indoor air contaminants. These gaseous materials include paints and solvents, cooking and cigarette smoke, and car exhaust. The Sensor must compensate for temperature and humidity, have span and calibration potentiometers, operate on 24 VDC power with output of 0-10 VDC and operating between 32 to 140 degrees F and 5 to 95 percent RH. Provide isolation power supply for each sensor.

2.6.6 Input Switches

2.6.6.1 Insertion Freeze Protection Switch

Electric switch shall be capillary type. Provide special purpose insertion thermostats with flexible elements a minimum of 20 feet in length for coil face areas up to 40 square feet. Switch contacts shall be rated for motor starter circuit voltage being interrupted. Switch shall be equipped with auxiliary set of contacts for input of switch status to digital controller. Provide additional elements or longer elements for larger coils at the rate of 1-foot of element per 4 square feet of coil. Serpentine capillaries perpendicular to the air flow to uniformly sense the entire airflow. A freezing condition at 18-inch increments along the sensing element shall activate the thermostatic switch. Switch shall require manual reset after activation.

2.6.6.2 Electronic Airflow Measurement Stations and Transmitters

a. Station - Each station shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be of the RTD or thermistor type. The sensing elements shall be distributed across the duct cross section in the quantity and pattern set forth for measurements and instruments of ASHRAE 3 and SMACNA HVACTAB for the traversing of ducted air flows. The resistance to airflow through the airflow measurement station shall not exceed 0.08 inch water gage at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflow of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus 3 percent over a range of 125 to 2,500 fpm scaled to air volume.

b. Each transmitter shall produce a linear, temperature compensated 4 to 20 mA or 0 to 10 VDC output corresponding to the actual air flow. The transmitter shall be a 2-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the calibrated measurement.

2.6.7 Energy Metering

2.6.7.1 Electric Meters

Provide kilowatt-hour (kWh) meter as specified in Section _____, "_____", for building as indicated. Provide contacts for kilowatt (kW) pulse accumulation. Provide kilowatt-hour (kWh) meter for building as indicated. Integrate electric meter signal into DDC system; meter signal output must be compatible with DDC input. DDC shall measure both instantaneous and accumulated electrical usage.

a. Meter: ANSI C12.10. Provide watt-hour meter and socket corresponding to the ratios of the current transformers and transformer secondary voltage. Meters shall be selected for __ -volt, three-phase, three, four -wire wye, delta system, three-element type with three current transformers. Meters shall be complete with a box mounted socket having automatic circuit closing bypass. Provide watt-hour meter with not less than four pointer-type kWh registers, provisions for pulse initiation, and a universal Class 2 indicating maximum kW demand register, sweep pointer indicating type, with a 15, 30, 60 -minute interval. Meter accuracy shall be within plus or minus one percent. The correct multiplier shall be provided on face of meter.

b. Current Transformers: ANSI C57.13. Provide three current transformers with 600-volt insulation, rated for metering with voltage, BIL, momentary, and burden ratings coordinated with the ratings of the associated meters. Provide a butyl molded donut or window type transformers mounted on a bracket to allow secondary cables to connect to the transformer bushings. Identify the wiring of the current transformer secondary feeders to permit field current measurements to be taken with hook-on ammeters.

2.6.7.2 Steam Meters

Provide vortex steam meters as shown on drawings. Steam meters, on pressure lines below 100 psig, or where pressures may fluctuate, shall be pressure compensated. All steam meters shall have a minimum turndown ratio of 10 to 1. Meter signal output must be compatible with DDC input. DDC shall measure both instantaneous and accumulated steam flow.

2.7 OUTPUT HARDWARE

2.7.1 Dampers

Damper shall conform to SMACNA DCS.

a. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sized damper shall be made from a combination of sections.

b. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blades shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature

range of minus 40 degrees F to 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5 inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gage at 1000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500.

c. Operating links external to dampers (such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Moving parts in contact with one another shall be of different materials. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed position of dampers.

2.7.2 Valves

2.7.2.1 Valve Assembly

Valves shall have stainless steel stems. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall conform to ASME/ANSI B16.5 as a minimum. Cast iron valve components shall conform to ASTM A 126 Class B or C as a minimum.

2.7.2.2 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and for modulation to the fully closed position, with noncorrosive discs, stainless steel shafts supported by bearing, and EPDM seats suitable for temperatures from minus 20 degrees F to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator.

2.7.2.3 Two-Way Valves

Two-way modulating valves shall have equal percentage characteristics.

2.7.2.4 Three-Way Valves

Three-way valves shall have equal percentage characteristics.

2.7.2.5 Duct Coil and Terminal Unit Coil Valves

Provide control valves with either flare-type or solder-type ends provided for duct or terminal-unit coils. Provide flare nuts for each flare-type end valve.

2.7.2.6 Valves for Chilled Water, Condenser Water and Glycol Service

a. Bodies for valves 1 1/2 inches and smaller shall be brass or

bronze, with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of brass, bronze or iron. Bodies for 2 inch valves shall have threaded ends. Bodies for valves from 2 1/2 to 3 inches shall have flanged-end connections. Internal valve trim shall be brass or bronze except that valve stems may be Type 316 stainless steel. Water valves shall be sized for a 3 psi differential through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow.

b. Valves 4 inches and larger shall be butterfly valves.

2.7.2.7 Valves for Hot Water Service

Valves for hot water service below 250 Degrees F:

a. Bodies for valves 1 1/2 inches and smaller shall be brass or bronze with threaded or union ends. Bodies for valves larger than 2 inches shall have flanged-end connections. Water valves shall be sized for a 3 psi differential through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow.

b. Internal trim, including seats, seat rings, modulation plugs, and springs, of valves controlling water hotter than 210 degrees F shall be Type 316 stainless steel.

c. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze.

d. Non-metallic parts of hot water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher.

e. Valves 4 inches and larger shall be butterfly valves.

2.7.2.8 Valves for Steam Service

Entire bodies for valves 1 1/2 inches and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 2 to 3 inches inclusive shall be of brass, bronze, or iron. Bodies for valves 4 inches and larger shall be iron. Bodies for 2 inch valves shall have threaded ends. Provide bodies for valves 2 1/2 inches and larger shall with flanged-end connections. Steam valves shall be sized for 15 psig ____ inlet steam pressure with a maximum 13 psi _____ differential through the valve at rated flow, except as indicated otherwise.

2.7.2.9 Valves for High Temperature Hot Water Service

Valves for high temperature hot water service above 250 Degrees F. Valve bodies shall conform to ASME/ANSI B16.34 Class 300. Valve and actuator combination shall be normally closed. Bodies shall be carbon steel, globe type with welded ends on valves 1 inch and larger. Valves smaller than 1 inch shall have socket-weld ends. Packing shall be virgin polytetrafluoroethylene (PTFE). Internal valve trim shall be Type 316

stainless steel. Water valves shall be sized for a 3 psi through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow.

2.7.3 Actuator

2.7.3.1 Electric Actuators

Provide direct drive electric actuators for all control applications. When operated at rated voltage, each actuator shall be capable of delivering torque required for continuous uniform motion and shall have end switch to limit travel, or shall withstand continuous stalling without damage. Actuators shall function properly with range of 85 to 110 percent of line voltage. Provide gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torque less than 16 inch pounds. Provide hardened steel running shafts in sleeve bearing of copper alloy, hardened steel, nylon, or ball bearing. Provide two-position actuators of the single direction, spring return, or reversing type. Provide proportioning actuators capable of stopping at all points in the cycle and starting in either direction, from any point. Provide reversing and proportioning actuators with limit switches to limit travel in either direction unless operator is stall type. Actuators shall have a simple switch for reversing direction, and a button to disengage clutch for manual adjustments. Provide reversible shaded pole, split capacitor, synchronous, or stepper type electric motors.

2.7.3.2 Pneumatic Actuators

Provide piston or diaphragm type actuator with full range or split range springs to provide required sequence specified and fail safe operation.

2.7.4 Output Signal Conversion

2.7.4.1 Electronic to Pneumatic Transducer

Electronic to pneumatic transducer shall convert 4 to 20 mA or 0 to 10 VDC digital controller output signal to a proportional 0 to 20 psig pressure signal (operator scaleable). Accuracy shall be 1.0 percent or better. Linearity shall be 0.1 percent. Transducer shall have feedback circuit that converts pneumatic signal to a proportional 4 to 20 mA or 0 to 10 VDC signal.

2.7.4.2 Pneumatic to Electronic Pressure Transducer

Pneumatic to electronic transducer shall convert 0 to 20 psig signal to a proportional 4 to 20 mA or 0 to 10 VDC signal (operator scaleable). Supply voltage shall be 24 VDC. Accuracy shall be 1.0 percent or better. Linearity shall be 0.1 percent.

2.7.5 Output Switches

2.7.5.1 Control Relays

Shall be double pole, double throw (DPDT), UL listed, with contacts rated to the application, indicator light, and dust proof enclosure. Light indicator is lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed base, and replaceable without need of tools or removing wiring. Encapsulated "PAM"

type relays are permissible for terminal control applications.

2.7.5.2 Solenoid Air Valves

Each valve shall have three port operation: common, normally open, and normally closed. Internal parts shall be brass, bronze, or stainless steel. Valves shall be rated at 50 psig minimum when used in a control system operating at 25 psig or less, or 150 psig when used in a control system operating in the range 25 to 100 psig.

2.8 ELECTRICAL POWER AND DISTRIBUTION

For control power provide a new, dedicated source 120 volts or less, 60 Hz, three wire (black, white, and green). Run green ground wire to panel ground; conduit grounds are not sufficient.

2.8.1 Transformers

Transformers shall conform to UL 506. Power digital controllers and terminal control units (TCU's) from dedicated circuit breakers with surge protection specified. Transformers for digital controllers serving terminal equipment on lower level LANs may be grouped to have specified surge protection sized for the number of controllers on a single transformer. Provide a fuse on the secondary side of the transformer.

2.8.2 Surge Protection

Surge and transient protection consist of devices installed externally to digital controllers.

2.8.2.1 Power Line Surge Protection

Surge suppressors external to digital controller, shall be installed on all incoming AC power. Surge suppressor shall be rated by UL 1449, have a fault indicating light, and have clamping voltage ratings below the following levels:

a. Unit is a transient voltage surge suppressor 120 VAC/1 phase/2 wire plus ground, hard wire individual equipment protector.

b. Unit must react within 5 nanoseconds and automatically reset.

c. Voltage protection threshold, line to neutral, starts at no more than 211 volts peak on the 120 VAC line.

d. The transient voltage surge suppressor must have an independent secondary stage equal to or greater than the primary stage joule rating.

e. The primary suppression system components must be pure Silicon Avalanche Diodes.

f. Silicon Avalanche Diodes or Metal Oxide Varistors are acceptable in the independent secondary suppression system.

g. The Transient Suppression System shall incorporate an indication light which denotes whether the primary and/or secondary transient protection components is/are functioning.

h. All system functions of the Transient Suppression System must be individually fused and not short circuit the AC power line at any time.

i. The Transient Suppression System shall incorporate an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.

j. The system must comply with IEEE C62.41, Class "B" requirements and be tested according to IEEE C62.45.

k. The system shall operate at -20 degrees C to +50 degrees C.

2.8.2.2 Controller Input/Output Protection

Controller input/output points shall surge protection with optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

2.8.3 Wiring

Provide complete electric wiring for DDC System, including wiring to transformer primaries. Control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 Volts shall be in accordance with Section 26 20 00, "Interior Distribution System." Circuits operating at 100 Volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways or wire trays, armored cable, or multi-conductor cable. Provide circuit and wiring protection as required by NFPA 70. Aluminum-sheathed cable or aluminum conduit may be used but shall not be buried in concrete. Use conduit or plenum-rated cable in HVAC plenums. HVAC plenums include the space between a drop ceiling and the architectural ceiling, within walls, and within ductwork. Protect exposed wiring from abuse and damage.

2.8.3.1 AC Control Wiring

a. Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.

b. Wiring for 120 V shall be 14 AWG minimum and rated for 600 V service.

2.8.3.2 Analog Signal Wiring

Analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded, and have 20 AWG drain wire. Each wire shall have insulation rated to 300 V ac. Cables shall have an overall aluminum-polyester or tinned-copper (cable-shield tape). Install analog signal wiring in conduit separate from AC power circuits.

2.9 FIRE PROTECTION DEVICES

Provide smoke detectors in return and supply air ducts on downstream side of filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL listed or FM approved detectors for duct installation.

2.9.1 Smoke Detectors

Provide in systems having air handling capacity over 15,000 cfm in accordance with NFPA 90A. Furnish detectors under Section 28 31 74.00 20, "Interior Fire Detection and Alarm System," and install under this section. Smoke control and exhaust systems shall have provision for automatic and manual operation by means of a key operated switch to override any other shut down features and shall be located adjacent to the fire alarm system control panel as indicated.

Provide in systems having air handling capacity over 15,000 cfm in accordance with NFPA 90A. Design for detection of abnormal smoke densities by the ionization or photoelectric principle, responsive to both invisible and visible particles of combustion, and not susceptible to operation by changes to relative humidity. Provide UL listed or FM approved detectors for duct installation. Provide duct detectors with an approved duct housing, mounted exterior to the duct, and with perforated sampling tubes extending across the width of the duct. Provide permanent descriptive zone labels indicating in which air handling units the detectors in alarm are located. Provide detectors with a test port test switch and or remote keyed test device. Provide control and power modules required for operation of detectors in their own control unit or integral with the main building fire alarm control panel. A ground fault or single break or open condition in the electrical circuitry to detector or its control or power units shall cause activation of the building fire alarm control panel trouble signals. Electrical supervision of wiring provided exclusively for air handling unit shutdown is not required provided a break in wiring will cause shutdown of the associated unit. Equipment and devices shall be compatible and operable in all respects with, and shall in no way impair reliability or operational functions of, existing building fire alarm system. Existing fire alarm control panel was manufactured by _____. Smoke control and exhaust systems shall have provisions for automatic and manual operation by means of a key-operated switch to override shutdown features and shall be located adjacent to the fire alarm system control panel as indicated.

Provide in systems having air handling capacity over 15,000 cfm in accordance with NFPA 90A except as otherwise indicated. Design for detection of abnormal smoke densities by the ionization or photoelectric principle, responsive to both invisible and visible particles of combustion, and not susceptible to operation by changes to relative humidity. Provide UL listed or FM approved detectors for duct installation. Provide duct detectors with an approved duct housing, mounted exterior to duct, and with perforated sampling tubes extending across width of duct. Provide 115 V ac power supply unit integral with duct housing. Obtain power from source to air handling unit or air handling unit controls location indicated. Detectors shall have test port or test switch. Provide remote alarm indicator and keyed test device at _____ location indicated. Provide each detector with a visible indicator lamp that lights when detector is activated. Activation of duct detector shall cause shutdown of associated air handling unit and closing of dampers and shall sound an alarm bell, minimum 6 inch diameter in a normally occupied area located as directed as shown. Provide a separate bell for each air handling unit, with an engraved plastic or metal label indicating which unit each bell annunciates.

2.10 INDICATORS

2.10.1 Thermometers

Provide bi-metal thermometers in locations as indicated. Bi-metal thermometers shall have either 9 inch scales or 3.5 inch dials and shall have insertion, immersion or averaging elements as indicated. Provide thermowells for liquid sensing applications. Select thermometer ranges so normal temperatures are approximately equal to midpoint readings on the scale.

2.10.2 Pressure Gages

a. Provide pressure gages for all pneumatic outputs. Select gage range so normal pressures are approximately equal to the midpoint readings on the scale, unless otherwise specified. Accuracy shall be plus or minus 2 percent of the range. Gages shall conform to ANSI/ASME B40.1.

b. Gages indicating pneumatic outputs shall have 2 inch diameter faces. Scale shall be 0 to 30 psi, with 1 psi graduations.

c. Gages for low differential pressure measurements shall be 4 1/2 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm actuated pointer, white dial with black figures, and pointer zero adjustment. Gage shall have ranges and graduations as shown. Accuracy shall be plus or minus 2 percent of scale range.

2.11 PNEUMATIC POWER SUPPLY AND TUBING

2.11.1 Air Compressors

Provide tank mounted, duplex, electric motor driven, oil type, air cooled, reciprocating type air compressor including motor, controller, pressure switch, belt guard, pressure relief valve, and automatic moisture drain valve. Piston speed shall not exceed 450 fpm. Set relief valve for 10 to 25 psig above the control switch cut-off pressure. Pressure switch shall start compressor at 70 psig and stop compressor at 90 psig. Size each compressor to run not more than 33, 50 percent of the time with full system control load. Compressor shall have maintaining type starter for automatic restart after power failure. Provide duplex air compressors with electric alternator switch assembly. Motors 0.5 hp and larger shall be three-phase, 208 or 460-volt, 60 Hz.

2.11.2 Compressed Air Tank

Provide steel tank constructed and labeled in accordance with ASME BPVC SEC VIII for a minimum of 125 psig working pressure. Tank shall be of sufficient volume so that the run time is not more than 50 percent for duplex or 33 percent for simplex units.

2.11.3 Intake Air Filter and Silencer

Provide dry-type combination intake air filter and silencer with baked enamel steel housing. Filter shall be 99 percent efficient at 10 micron rating.

2.11.4 Refrigerated Air Dryer

a. Provide a refrigerant dryer sized for continuous operation to reduce the compressed air dew point temperature, at 20 psig output pressure, to 30 degrees F with average tank pressure of 80 psig and ambient air temperature between 55 and 95 degrees F. Provide dryer with an automatic condensate drain trap with a manual override feature. Provide refrigerant gages for suction lines.

b. Connect dryer in the high pressure piping between tank and pressure -reducing valve.

2.11.5 Compressed Air Discharge Filter

a. Provide dry type filter, 99 percent efficient in removing oil and solid particles at 0.03 micron rating, with baked enamel steel housing and manual drain valve. Provide visual indicator to show when oil filter element should be changed.

b. Provide disposable filter directly before each control module with pneumatic outputs, Disposable filter shall eliminate 99.99 percent of all liquid or solid contaminants 0.1 micron or larger. Provide filter with easy to remove fittings.

2.11.6 Air Pressure-Reducing Station

Provide pressure-reducing valve (PRV) with field adjustable range of 0 to 50 psig discharge pressure, with inlet pressure of 70 to 90 psig. Provide factory-set pressure relief valve to relieve overpressure downstream of PRV exceeding 25 psig. Provide inlet pressure gage with range of 0 to 100 psig and outlet pressure gage with range of 0 to 30 psig. For two pressure systems, provide an additional PRV and outlet pressure gage.

2.11.7 Pneumatic Tubing

2.11.7.1 Copper Tubing

Provide ASTM B 75 or ASTM B 88 rated tubing. Tubing 0.375 inch outside diameter and larger shall have minimum wall thickness equal to ASTM B 88, Type M. Tubing less than 0.375 inch outside diameter shall have minimum wall thickness of 0.025 inch. Concealed tubing shall be hard or soft copper; multiple tubing shall be racked or bundled. Exposed tubing shall be hard copper; rack multiple tubing. Tubing for working pressures greater than 30 psig shall be hard copper. Bundled tubing shall have each tube numbered each six feet minimum. Racked and individual tubes shall be permanently identified at each end. Fittings shall be solder type ANSI B16.18 or ASME/ANSI B16.22, using ASTM B 32, 95-5 tin-antimony solder, or compression type ASME/ANSI B16.26.

2.11.7.2 Polyethylene Tubing

Provide flame-resistant, multiple polyethylene tubing in flame-resistant protective sheath, or unsheathed polyethylene tubing in rigid metal, intermediate metal, or electrical metallic tubing conduit for areas where tubing is exposed. Single, unsheathed, flame-resistant polyethylene tubing may be used where concealed in walls or above ceilings and within control panels. Provide polyethylene tubing only for working pressures of 30 psig or less. Number each tube in sheathing each two feet minimum. Permanently identify unsheathed tubing at each end. Fittings shall be compression or

barbed push-on type. Do not provide polyethylene tubing for smoke removal systems. Extruded seamless polyethylene tubing shall conform to the following:

a. Minimum Burst Pressure Requirements: 100 psig at 75 degrees F to 25 psig at 150 degrees F;

b. Stress Crack Resistance: ASTM D 1693, 200 hours minimum;

c. Tensile Strength (Minimum): ASTM D 638, 1100 psi;

d. Flow Rate (Average): ASTM D 1238, 0.30 decigram per minute; and

e. Density (Average): ASTM D 792, 920 kg/m3.

2.12 VARIABLE FREQUENCY MOTOR DRIVES

The variable frequency drive (VFD) shall convert 240 or 460 volt (+/- 10%), three phase, 60 hertz (+/- 2Hz), utility grade power to adjustable voltage/frequency, three phase, AC power for stepless motor control from 5% to 105% of base speed.

2.12.1 Description

The variable frequency drive (VFD) shall produce an adjustable AC voltage/ frequency output for complete motor speed control. The VFD must meet all of the following criteria.

a. The VFD shall use sinecoded PWM technology. The sinecoded PWM calculations are performed by the VFD microprocessor.

b. The VFD shall use IGBT transistors for the inverter's three phase output.

c. The VFD shall use a three phase diode bridge converter to charge the VFD constant voltage capacitor buss.

d. The VFD shall have the ability for control by either a remote 4-20 mA 0 to 10 VDC control signal or from a local control panel located on the VFD itself.

e. The VFD shall use microprocessor technology for VFD control. The VFD shall be programmable with a permanently mounted keypad included with each VFD.

f. The VFD shall be fully self diagnostic. No external programmers, analyzers, interrogators, or diagnostic boards, shall be needed to annunciate VFD faults or drive internal status.

2.12.2 Code Standards

VFD shall be UL listed as delivered to the end user. The VFD shall meet current National Electrical Code.

2.12.3 VFD Quality Assurance

To ensure quality, each and every VFD shall be subject to a series of in-plant quality controlled inspections before approval for shipment from the manufacture's facilities.

a. All components shall be tested prior to assembly and the complete unit shall be tested under full load conditions to ensure maximum product reliability.

b. The VFDs shall be the current standard production unit with at least 10 identical units already in the field.

c. Engineering support shall be available from the factory of the VFD. Phone support shall be free of charge to the end user for the life of the equipment. Factory support shall be available in the English language.

2.12.4 VFD Service

The VFD shall be supplied with:

a. 24 month parts and labor warranty. The warranty shall start when the system is accepted by the end user or 30 months from date of shipment.

b. Installation, operation, and troubleshooting guide(s).

2.12.5 Basic VFD Features

The VFD shall have the following basic features with no more then three separate internal electronic boards.

a. VFD mounted operator control keypad capable of:

(1) Remote/Local operator selection with password access.

(2) Run/Stop and manual speed commands.

(3) All programming functions.

(4) Scrolling through all display functions.

b. Digital display capable of indicating:

(1) VFD status.

(2) Frequency.

(3) RPM of motor.

(4) Phase current.

(5) Fault diagnostics in descriptive text.

(6) All programmed parameters.

c. Standard PI loop controller with input terminal for controlled variable and parameter settings made while inverter running.

d. User interface terminals for end-user remote control of VFD speed, speed feedback, and isolated form C SPDT relay energized on drive fault condition.

e. An isolated form C SPDT auxiliary relay energized on run command.

f. The VFD shall have a NEMA 1 enclosure for inside installation and NEMA 3R, 4X for exterior installation.

g. The VFD shall have an adjustable carrier frequency with 16 KHz minimum upper limit.

h. The VFD shall have a built in or external line reactor with 3% minimum impedance to protect DC buss capacitors and rectifier section diodes.

2.12.6 Programmable Parameters

The VFD shall include the following operator programmable parameters:

a. Upper limit frequency.

b. Lower limit frequency.

c. Acceleration rate.

d. Deceleration rate.

e. Variable torque volts per Hertz curve.

f. Starting voltage level.

g. Starting frequency level.

h. Display speed scaling.

i. Enable/disable auto-restart feature.

j. Enable/disable softstall feature.

k. Motor overload level.

l. Motor stall level.

m. Jump frequency and hysteresis band.

n. PWM carrier frequency.

2.12.7 Protective Circuits and Features

a. An electronic adjustable inverse time current limit with consideration for additional heating of the motor at frequencies below 45Hz, for the protection of the motor.

b. An electronic adjustable soft stall feature, allowing the VFD to lower the frequency to a point were the motor will run at FLA when an overload condition exists at the requested frequency. The VFD will automatically return to the requested frequency when load condition permit.

c. The VFD will have a separate electronic stall at 110% VFD rated current and a separate hardware trip at 190% current.

d. The VFD shall have ground fault protection that protects output cables and motor from grounds during both starting and continuous running conditions.

e. The VFD shall have the ability to restart after the following faults:

(1) Overcurrent (drive or motor).

(2) Power outage.

(3) Phase loss.

(4) Overvoltage/Undervoltage.

f. The VFD shall restart into a rotating load without tripping or damaging the VFD or the motor.

g. The VFD shall keep a log of a minimum of four previous fault conditions, indicating type and time of occurance in descriptive text.

h. The VFD shall be able to sustain 110% rated current for 60 sec.

i. The VFD shall respond to and record the following fault conditions:

(1) Over current (and have an indication if the over current was during acceleration, deceleration, or running).

(2) Overcurrent internal to the drive.

(3) Motor overload at start-up.

(4) Over voltage from the utility power.

(5) Motor running overload.

(6) Overvoltage during deceleration.

(7) VFD over heat.

(8) Load end ground fault.

(9) Abnormal parameters or data in VFD EEPROM.

2.12.8 Operational Conditions

The VFD shall be designed and constructed to operate within the following service conditions.

a. Ambient Temperature Range, 0 to 120 deg. F.

b. Non-condensing relative humidity to 90%.

2.12.9 Available Options

Provide Allow for future capability of the following options:

a. RFI/EMI filters

b. RS232 or RS422/485 interface card with application software which can both control and monitor the VFD from a attached computer.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under supervision of competent technicians regularly employed in the installation of DDC systems.

3.1.1 Wiring Criteria

a. Input/output identification: Permanently label each field wire, cable, or pneumatic tube at each end with unique descriptive identification.

b. Rigid or flexible conduit shall be terminated at all sensors and output devices.

c. Surge Protection: Install surge protection per manufacturer's specification.

d. Grounding: Ground controllers and cabinets to a good earth ground. Ground controller to a ground in accordance with Section 26 20 00, "Interior Distribution System." Grounding of the green ac ground wire, at the breaker panel, alone is not adequate. Run metal conduit from controller panels to adequate building grounds. Ground sensor drain wire shields at controller end.

e. Contractor is responsible for correcting all associated ground loop problems.

d. Wiring in panel enclosures shall be run in covered wire track.

3.1.2 Digital Controllers

a. Do not divide control of a single mechanical system such as an air handling unit, boiler, chiller, or terminal equipment between two or more controllers. A single controller shall manage control functions for a single mechanical system. It is permissible, however, to manage more than one mechanical system with a single controller.

b. Provide digital control cabinets that protect digital controller electronics from dust, at locations shown on the drawings.

3.1.3 Temperature Sensors

Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application.

3.1.3.1 Room Temperature Sensors

Provide on interior walls to sense average room temperature conditions. Avoid locations near heat sources or which may be covered by office

furniture. Room temperature sensors should not be mounted on exterior walls when other locations are available. Mount center of sensor at 5 feet above finished floor.

3.1.3.2 Duct Temperature Sensors

a. Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Install gaskets between the sensor housing and duct wall. Seal duct and insulation penetrations.

b. String duct averaging sensors between two rigid supports in a serpentine position to sense average conditions. Insulate temperature sensing elements from supports. Provide hinged duct access doors to install averaging sensors if needed.

c. Locate freeze protection sensors in appropriate locations to sense lowest temperatures, to avoid potential problems with air stratification.

3.1.3.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermowells with thermal transmission material within the well.

3.1.3.4 Outside Air Temperature Sensors

Provide outside air temperature sensor in weatherproof enclosure on north side of the building, away from exhaust hoods, air intakes and other areas that may affect temperature readings. Provide sunshields to from direct sunlight.

3.1.4 Damper Actuators

Actuators shall not be mounted in the air stream.

3.1.5 Thermometers

Provide thermometers at locations indicated. Mount thermometers to allow reading when standing on the floor.

3.1.6 Pressure Sensors

3.1.6.1 Differential Pressure

a. Duct Static Pressure Sensing: Locate duct static pressure tip approximately two-thirds of distance from supply fan to end of duct with the greatest pressure drop.

b. Pumping Proof with Differential Pressure Switches: Install high pressure side between pump discharge and check valve.

c. Steam Pressure Sensing: Install snubbers and isolation valves on steam pressure sensing applications.

3.1.7 Pressure Gages

Pneumatic output lines shall have pressure gages mounted near the digital controllers.

3.1.8 Pneumatic Tubing

Run concealed tubing in finished areas, and run exposed tubing in unfinished areas such as mechanical equipment rooms. For tubing to be enclosed in concrete, provide rigid metal conduit or intermediate metal conduit. Provide tubing parallel and perpendicular to building walls throughout. Maximum spacing between tubing supports shall be 5 feet. With the compressor turned off, test each tubing system pneumatically at 1.5 times the working pressure, with a maximum pressure drop of 1 psig. Correct leaks. Caulking of joints will not be permitted. Do not run tubing and electrical power conductors in the same conduit.

3.1.9 Control Drawings

a. Post laminated copies of as-built control system drawings in each mechanical room.

b. Provide 3 sets of as-built control drawings to the Contracting Officer.

3.2 TEST AND BALANCE SUPPORT

Controls contractor will coordinate with and provide full time on-site technical support to test and balance (TAB) personnel specified under Section 23 08 00.00 20 or any other documents in the project specification. This support shall include:

a. On-site operation of control systems for proper operating modes during all phases of balancing and testing.

b. Control setpoint adjustments for proper balancing of all relevant mechanical systems, including VAV boxes.

c. Setting all control loops with setpoints and adjustments determined by TAB personnel.

3.3 FIELD QUALITY CONTROL

3.3.1 General

a. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that test personnel are regularly employed in the testing and calibration of DDC systems.

b. Testing will include the field tests and the performance verification tests. Field tests shall demonstrate proper calibration of input and output devices, and the operation of

specific equipment. Performance verification test shall ensure proper execution of the sequence of operation and proper tuning of control loops.

c. Obtain approval of the field test plan and performance verification test play for each phase of testing before beginning that phase of testing. Give to the Contracting Officer written notification of planned testing at least 30 days prior to test. Notification shall be accompanied by the proposed test procedures. In no case will the Contractor be allowed to start testing without written Government approval of field test plan and performance verification test plan.

d. Before scheduling the performance verification test, furnish field test documentation and written Certified Statement of Field Test Completion to the Contracting Officer for approval. The statement, certified by the DDC system provider, states that the installed system has been calibrated, tested, and is ready for the performance verification test. Do not start the performance verification test prior to receiving written permission from the Government.

e. Tests are subject to oversight and approval by the Contracting Officer. The testing shall not be run during scheduled seasonal off-periods of heating and cooling systems.

3.3.2 Test Reporting for Field Testing and Performance Verification Tests

a. During and after completion of the Field Tests, and again after the Performance Verification Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and submit a written report to the Government.

b. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken. Provide a written report containing test documentation after the Field Tests and again after the Performance Verification Tests. Convene a test review meeting at the job site to present the results to the Government. As part of this test review meeting, demonstrate by performing all portions of the field tests or performance verification test that each failure has been corrected. Based on the report and test review meeting, the Government will determine either the restart point or successful completion of testing. Do not retest until after receipt of written notification by the Government. At the conclusion of retest, assessment will be repeated.

3.3.3 Contractor's Field Tests

Field tests shall include the following:

3.3.3.1 System Inspection

Observe the HVAC system in its shutdown condition. Check dampers and valves for proper normal positions. Document each position for the test report.

3.3.3.2 Calibration Accuracy and Operation of Inputs Test

Verify correct calibration and operation of input instruments. For each sensor and transmitter, including those for temperature, pressure, humidity, and air quality, record the reading at the sensor or transmitter location using calibrated test equipment. On the same table, record the corresponding reading at the digital controller for the test report.The test equipment shall have been calibrated within one year of use. Test equipment calibration shall be traceable to the measurement standards of the National Institute of Standards and Technology.

3.3.3.3 Actuator Range Adjustment Test

With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.

3.3.3.4 Digital Controller Startup and Memory Test

Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a power failure.

3.3.3.5 Surge Protection Test

Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on communications lines.

3.3.3.6 Application Software Operation Test

Test compliance of the application software for:

a. Ability to communicate with the digital controllers, uploading and downloading of control programs

b. Text editing program: Demonstrate the ability to edit the control program off line.

c. Reporting of alarm conditions: Force alarms conditions for each alarm, and ensure that workstation receives alarms.

d. Reporting trend and status reports: Demonstrate ability of software to receive and save trend and status reports.

3.3.4 Performance Verification Tests

Conduct the performance verification tests to demonstrate control system maintains setpoints, control loops are tuned, and controllers are programmed for the correct sequence of operation. Conduct performance verification test during seven days of continuous HVAC and DDC systems operation and before final acceptance of work. Specifically the performance verification test shall demonstrate the following:

3.3.4.1 Execution of Sequence of Operation

Demonstrate the HVAC system operates properly through the complete sequence of operation, for example seasonal, occupied/unoccupied, and warm-up.

Demonstrate proper control system response for abnormal conditions by simulating these conditions. Demonstrate hardware interlocks and safeties work. Demonstrate the control system performs the correct sequence of control after a loss of power.

3.3.4.2 Control Loop Stability and Accuracy

Furnish the Government graphed trends of control loops to demonstrate the control loop is stable and that setpoint is maintained. Control loop response shall respond to setpoint changes and stabilize in 3 minutes. Control loop trend data shall be real time and the time between data points shall not be greater than one minute. The contractor shall provide a printer at the job site for printing graphed trends. The printer shall remain on the job site throughout Performance Verification Testing to allow printing trends.

3.4 TRAINING

Submit a training course schedule, syllabus, and training materials 14 days prior to the start of training. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. Orient training to the specific system being installed under this contract. Use operation and maintenance manual as the primary instructional aid in contractor provided activity personnel training. Base training on the Operations and Maintenance manuals and a DDC training manual. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have a high school education and are familiar with HVAC systems.

3.4.1 DDC Training Phase I

The first class shall be taught for a period of 2 consecutive training days at least 2 weeks prior to the scheduled Performance Verification Test. The first course shall be taught in a government provided facility on base. Training shall be classroom, but have hands-on operation of similar digital controllers. A maximum of 5 _____ personnel will attend this course. Upon completion of this course, each student, using appropriate documentation, should be able to perform elementary operations, with guidance, and describe the general hardware architecture and functionality of the system. This course shall include but not be limited to:

a. Theory of operation

b. Hardware architecture

c. Operation of the system

d. Operator commands

e. Control sequence programming

f. Data base entry

g. Reports and logs

h. Alarm reports

i. Diagnostics

3.4.2 DDC Training Phase II

The second course shall be taught in the field, using the operating equipment at the project sites for a total of 2 consecutive days. A maximum of 5 _____ personnel will attend the course. The course shall consist of hands-on training under the constant monitoring of the instructor. Course content should duplicate DDC Training Phase I course as applied to the installed system. The instructor shall determine the level of the password to be issued to each student before each session. Upon completion of this course, students should be fully proficient in the operation of each system function.

-- End of Section --

SECTION 23 73 33

HEATING, VENTILATING, AND COOLING SYSTEM

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)

AHAM Directory	(2002) Directory of Certified Room Air Conditioners

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1999) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 500	(1994) Test Methods for Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22	(1999; 2001) Relief Valves for Hot Water Supply Systems
ANSI Z21.64	(1990; Addenda 1992) Direct Vent Central Furnaces

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI DCAACP	Directory of Certified Applied Air Conditioning Products
ARI UD	Directory of Certified Unitary Air Conditioning Equipment
ARI 210/240	(1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 310/380	(1993) Packaged Terminal Air-Conditioners and Heat Pumps
ARI 320	(1998) Water-Source Heat Pumps
ARI 340/360	(2000) Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
ARI 365	(1994) Commercial and Industrial Unitary Air-Conditioning Condensing Units

ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1999) Central-Station Air-Handling Units
ARI 440	(1998) Room Fan-Coil and Unit Ventilator
ARI 590	(1992) Positive Displacement Compressor Water-Chilling Packages
ARI 710	(1995) Liquid-Line Driers
ARI 880	(1998) Air Terminals

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(2001) Safety Standard for Mechanical Refrigeration System

ASME INTERNATIONAL (ASME)

ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(2001) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2001) Cast Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(1992) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME/ANSI B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME/ANSI B16.34	(1996) Valves Flanged, Threaded and Welding End
ASME/ANSI B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B31.1	(2001) Power Piping
ASME/ANSI B31.5	(2001) Refrigeration Piping and Heat Transfer Components

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(2001) Water Pressure Reducing Valves

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 193/A 193M	(2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(2001a) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 525	(1991; Rev. B) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock-Forming Quality
ASTM B 32	(2000) Solder Metal
ASTM B 42	(1998) Seamless Copper Pipe, Standard Sizes
ASTM B 88	(1999el) Seamless Copper Water Tube
ASTM B 280	(1999el) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 306	(1999) Copper Drainage Tube (DWV)
ASTM C 1071	(2000) Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material
ASTM D 4021	(1992) Glass-Fiber-Reinforced Polyester Underground Petroleum Storage Tanks

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC	(2002) List of Approved Backflow Prevention Assemblies

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(2002) Butterfly Valves
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993 R 2001) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2001) Installation of Oil Burning Equipment
NFPA 70	(2002) National Electrical Code
NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA R&W Manual	(2001, 5th Ed) NRCA Roofing and Waterproofing Manual

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Const Stds	(1995; Addenda Nov 1997; 6th Printing 2001) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Leakage Test Mnl	(1985; 6th Printing 1997) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(1999) Building Materials Directory
UL Elec Equip Dir	(2001) Electrical Appliance and Utilization Equipment Directory
UL 142	(1993; Rev Jul 1998) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 181	(1996; Rev Dec 1998) Factory-Made Air Ducts and Air Connectors
UL 296	(1994; Rev Sep 1998) Oil Burners
UL 507	(1999; Rev thru Sep 2001) Electric Fans

UL 555	(1999; Rev thru Jan 2002) Fire Dampers
UL 726	(1995; Rev thru Jan 1999) Oil-Fired Boiler Assemblies
UL 1316	(1994; Rev Apr 1996) Glass-Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures

1.2 SYSTEM DESCRIPTION

Provide new and modify existing heating, ventilating, and cooling (HVAC) systems complete and ready for operation. HVAC systems include equipment, ducts, and piping which is located within, on, under, and adjacent to buildings.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Temperature control systems

Automatic Flow Control Valves (AFCV)

Equipment layout drawings for:

(1) Chillers

(2) Condensing Units

(3) _____

SD-03 Product Data

Packaged air-conditioners

Split-system air-conditioners

Packaged heat pumps

Split-system heat pumps

Packaged air-handling units

Multizone air-handling units

Air-cooled water chillers

Air-cooled condensing units

Room fan-coil air-conditioners

Room air-conditioners

Packaged terminal air-conditioners

Packaged terminal heat pumps

Computer room air-conditioners

Series fan powered variable air volume (VAV) terminals

Water-source heat pumps

Liquid cooling radiators

Cabinet unit heaters

Unit heaters

Convectors

Finned tube radiation

Hot water converters

Oil-fired heating boilers and underground fuel oil storage tank

Pumps, including performance curves for each impeller size

Exhaust fans

Direct vent gas-fired central furnaces

Fire dampers

Expansion tanks

Air separators

Heat tape

Pipe hangers and supports

Flexible pipe connectors

Dampers

Diffusers, registers, and grilles

Outside air intake louvers

Duct heaters

Filter boxes

Flexible round ducts

Duct lining

Valves

Pipe and fittings

Solids-from-water separator

SD-06 Test Reports

Packaged air-conditioners: greater than 180,000 Btuh.

Split-system air-conditioners: greater than 180,000 Btuh.

Packaged heat pumps: greater than 60,000 Btuh.

Split-system heat pumps: greater than 60,000 Btuh.

Water-source heat pumps: greater than 60,000 Btuh.

Packaged air-handling units: greater than 2,000 cfm.

Multizone air-handling units: greater than 2,000 cfm.

Air-cooled water chillers: greater than 180,000 Btuh.

Series fan powered variable air volume (VAV) terminals and related air handling unit.

Computer room air-conditioners.

SD-07 Certificates

Certification of welders' qualifications

Equipment field test plans

SD-08 Manufacturer's Instructions

Installation manual

SD-10 Operation and Maintenance Data

Packaged air-conditioners, Data Package 3

Split-system air-conditioners, Data Package 3

Packaged heat pumps, Data Package 3

Split-system heat pumps, Data Package 3

Packaged air-handling units, Data Package 3

Multizone air-handling units, Data package 3

Air-cooled water chillers, Data Package 3

Air-cooled condensing units, Data Package 3

Room fan-coil air-conditioners, Data Package 2

Room air-conditioners, Data Package 2

Packaged terminal air-conditioners, Data Package 2

Packaged terminal heat pumps, Data Package 2

Computer room air-conditioners, Data Package 4

Series fan powered variable air volume (VAV) terminals, Data Package 3. Submit with respective air handling unit.

Water-source heat pumps, Data Package 2

Liquid cooling radiators, Data Package 2

Unit heaters, Data Package 2

Oil-fired heating boilers and underground fuel oil storage tank, Data Package 3

Pumps, Data Package 2

Exhaust fans, Data Package 2

Direct vent gas-fired central furnaces, Data Package 3

Fire dampers, Data Package 1

Submit in accordance with Section 01 78 23, "Operation and Maintenance Data."

SD-11 Closeout Submittals

Air-cooled condensing units start-up report

Air-cooled water chillers start-up report

Air filter inventory

1.3.1 Temperature Control Systems

Drawings shall include point-to-point electrical wiring diagrams.

1.3.2 Automatic Flow Control Valves (AFCV)

Submit drawings showing location and model of each AFCV. Show HVAC equipment and requirements, piping, and pressure drops across the AFCV. Show gpm, size and spring ranges of AFCV.

1.3.3 Equipment layout drawings

Submit drawings showing equipment layout including foot print, piping, conduit, control cabinets, door swings, and power disconnects.

1.3.4 Installation Manual

Provide for each item of equipment.

1.3.5 Certification of Welders' Qualifications

Submit copy of Welder Qualification Tests (Form QW-482) prior to site welding.

1.3.6 Equipment Field Test Plans

Submit within 120 calendar days after contract award for the following equipment.

a. Air conditioners: packaged and split-system; greater than 180,000 Btuh.

b. Heat pumps: packaged, split-system, and water-source; greater than 60,000 Btuh.

c. Air-handling units: packaged and multi-zone; greater than 2,000 cfm.

d. Air-cooled water chillers: greater than 180,000 Btuh.

e. Variable air volume (VAV) terminals and related air handling unit.

f. Computer room air conditioners.

1.3.7 Air Filter Inventory

Submit an inventory of sizes and quantity of air filters required to be replaced. Inventory shall indicate location of each piece of equipment. Include sketches of drawings.

PART 2 PRODUCTS

2.1 EQUIPMENT

Dehydrate, purge, and charge refrigerant circuit with refrigerant and oil at factory. Factory oil and refrigerant charge shall be full amount required for operation, if within limits permitted by the Department of Transportation; otherwise, a holding charge shall be furnished. Field charging, where only a holding charge is shipped, shall be accomplished without breaking permanent refrigerant connections. Equipment using R-11, R-12, R-13, R-113, R-114, R-115, R-500, or R-502 as a refrigerant will not be permitted. Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Program. Refrigerants that operate any where in the cycle below 20 psia will not be permitted. Efficiency of equipment shall meet the minimum's of Table 15701-1.

2.1.1 Packaged Air-Conditioners

Provide single package unit factory assembled, designed, tested, and rated in accordance with ARI 210/240 or ARI 340/360 for cooling. Unit shall be ARI certified or rated in ARI UD for cooling. Provide guards to protect condenser fins. Unit shall be listed in UL Elec Equip Dir. Unit shall include fans, evaporator coil, filters, low leakage dampers, compressor, condenser, and controls. Provide heating section when indicated. Insulate interior of casing with manufacturer's standard insulation.

a. Filter section: Provide UL listed throwaway 1 inch thick fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity. Provide gasketed hinged access panel with quick opening half-twist latches at end of filter rack. Filter rack shall accept 2 inch thick filters.

b. Safety controls: Provide low refrigerant pressure protection and pressure relief device. Provide compressor motor with thermal and overload protection, 5 minute anti-recycle timer, and start capacitor kit. Provide compressor with electrical crankcase heater and internal high pressure protection. The above safety controls are not required when scroll compressors are provided.

c. Heating section: Provide ARI 410 hot water coils or nonfreeze double tube steam coils as indicated. Provide UL listed electric resistance heaters including internal fusing integral with heaters; fan shall run until heater cools.

d. Space temperature controls: Provide controls including adjustable programmable thermostats with COOL-OFF-HEAT system switch and AUTO-ON fan switch. Provide relays, transformers, contactors, and control wiring between thermostats and unit. Provide controls under Section 23 09 53.00 20, "Space Temperature Control Systems." Provide controls under Section 23 09 54, "Direct Digital Control Systems."

e. Weatherproof casing: Provide removable gasketed panels designed to exclude driving rain for access to fans, coils, filters, compressors, motors, and controls. Provide weatherproof outside air intake louvers or weatherproof hoods with moisture eliminators.

f. Roof curbs: Provide factory-fabricated galvanized steel roof curbs, wood nailers, insulation, and seal strips in accordance with NRCA R&W Manual curb detail for rooftop air-handling units. Roof curbs shall be furnished by unit manufacturer.

g. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

2.1.2 Split-System Air-Conditioners

Provide units factory assembled, designed, tested, and rated in accordance with ARI 210/240 or ARI 340/360 for cooling. Units shall be ARI certified or rated in ARI UD for cooling. Outside unit shall include compressor and condenser. Provide guards to protect condenser fins. Units shall be listed in UL Elec Equip Dir. Units shall include blower fan, evaporator coil, filters, and controls. Provide heating section indicated. Insulate interior of inside unit casing with manufacturer's standard insulation.

a. Filter section: Provide UL listed throwaway 1-inch thick fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity. Provide gasketed hinged access panel with quick opening half-twist latches at end of filter rack. Filter rack shall accept 2 inch thick filters.

b. Safety controls: Provide low refrigerant pressure protection and pressure relief device. Provide compressor motor with thermal and overload protection, 5 minute anti-recycle timer, and start capacitor kit. Provide compressor with electrical crankcase heater and internal high pressure protection. The above safety

controls are not required when scroll compressors are provided.

c. Heating section: Provide ARI 410 hot water coil or nonfreeze double tube steam coil as indicated. Provide UL listed electric resistance heaters including internal fusing integral with heaters; fan shall run until heater cools.

d. Space temperature controls: Provide controls including adjustable programmable thermostats with COOL-OFF-HEAT system switch and AUTO-ON fan switch. Provide relays, transformers, contactors, and control wiring between thermostats and unit. Provide controls under Section 23 09 53.00 20, "Space Temperature Control Systems." Provide controls under Section 23 09 54, "Direct Digital Control Systems."

e. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

2.1.3 Packaged Heat Pumps

Provide single package unit factory assembled, designed, tested, and rated in accordance with ARI 210/240 or ARI 340/360. Unit shall be ARI certified or rated in ARI UD. Provide guards to protect condenser fins. Unit shall be listed in UL Elec Equip Dir. Unit shall include fans, evaporator coil, filters, low leakage dampers, compressor, condenser, and controls. Provide additional heating section when indicated. Insulate interior of casing with manufacturer's standard insulation.

a. Filter section: Provide UL listed throwaway 1-inch thick fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity. Provide gasketed hinged access panel with quick opening half-twist latches at end of filter rack. Filter rack shall accept 2 inch thick filters.

b. Safety controls: Provide low refrigerant pressure protection and pressure relief device. Provide compressor motor with thermal and overload protection, 5 minute anti-recycle timer, and start capacitor kit. Provide compressor with electrical crankcase heater and internal high pressure protection. The above safety controls are not required when scroll compressors are provided.

c. Supplemental heater section: Provide UL listed electric resistance heaters including internal fusing integral with unit; fan shall run until heater cools. Locate downstream of coils. Provide controls to operate heaters only when indoor thermostat is in heating mode and outdoor thermostat indicates outside temperature is below 35 degrees F or unit balance point, whichever is higher; and when unit is in defrost mode at any outside temperature.

d. Space temperature controls: Provide digital electronic controls including adjustable programmable thermostats with COOL-OFF-HEAT system switch and AUTO-ON fan switch. Thermostats shall be provided by unit manufacturer. Provide relays, transformers, contactors, and control wiring between thermostats and unit.

Provide controls under Section 23 09 53.00 20," Space Temperature Control Systems." Provide controls under Section 23 09 54, Direct Digital Control Systems."

e. Weatherproof casing: Provide removable gasketed panels designed to exclude driving rain for access to fans, coils, filters, compressors, motors, and controls. Provide weatherproof outside air intake louvers or weatherproof hoods with moisture eliminators.

f. Roof curbs: Provide factory-fabricated galvanized steel roof curbs, wood nailers, insulation, and seal strips in accordance with NRCA R&W Manual curb detail for rooftop air-handling units. Roof curbs shall be furnished by unit manufacturer.

g. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

2.1.4 Split-System Heat Pumps

Provide units factory assembled, designed, tested, and rated in accordance with ARI 210/240 or ARI 340/360. Units shall be ARI certified or rated in ARI UD. Outside unit shall include compressor and condenser. Provide guards to protect condenser fins. Unit shall include blower fan, evaporator coil, filters, and controls. Provide additional heating section when indicated. Insulate interior of inside unit casing with manufacturer's standard insulation. Insulate interior of inside unit casing with manufacturer's standard insulation.

a. Filter section: Provide UL listed throwaway 1 inch thick fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity. Provide gasketed hinged access panel with quick opening half-twist latches at end of filter rack. Filter rack shall accept 2 inch thick filters.

b. Safety controls: Provide low refrigerant pressure protection and pressure relief device. Provide compressor motor with thermal and overload protection, 5 minute anti-recycle timer, and start capacitor kit. Provide compressor with electrical crankcase heater and internal high pressure protection. The above safety controls are not required when scroll compressors are provided.

c. Supplemental heater section: Provide UL listed electric resistance heaters including internal fusing integral with indoor unit; fan shall run until heater cools. Locate downstream of indoor coil. Provide controls to operate heater only when indoor thermostat is in heating mode and outdoor thermostat indicates outside temperature is below 35 degrees F or unit balance point, whichever is higher; and when unit is in defrost mode at any outside temperature.

d. Space temperature controls: Provide controls including adjustable programmable thermostats with COOL-OFF-HEAT system switch and AUTO-ON fan switch. Thermostats shall be provided by unit manufacturer. Provide relays, transformers, contactors, and control wiring between thermostats and unit. Provide controls under Section 23 09 53.00 20, "Space Temperature Control Systems."

Provide controls under Section 23 09 54, "Direct Digital Control Systems."

e. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

2.1.5 Air-Handling Units

Provide units factory assembled, designed, tested, and rated in accordance with ARI 430. Units shall be ARI certified for cooling. Provide heating and cooling units including nonfreeze double tube steam coils hot water coils and direct expansion refrigerant coils with expansion devices and solenoid valves chilled water coils chilled-hot water coils. Unit shall include fan section, coil section with drain pan, low leakage face and bypass damper section, low leakage opposed blade damper section, inlet vortex damper section, variable frequency motor controller, filter section and access panels. Insulate interior of casing with manufacturer's standard insulation. Provide nylon bushings for dampers.

a. Fan section: Provide draw-through fan section including motor, starter, and drives. Provide adjustable sheaves to permit fan capacity variation from 5 percent above to 5 percent below rated capacity. Provide fan with discharge dampers or variable inlet vanes as indicated.

b. Coil section: Provide ARI 410 coils and slope for drainage. Provide insulated drain pans under cooling coils and valves. Provide direct expansion refrigerant coils with holding charge of dry nitrogen and seal.

c. Filter section: Provide UL listed throwaway 1 inch thick fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity. Provide gasketed hinged access panel with quick opening half-twist latches at end of filter rack. Filter rack shall accept 2 inch thick filters.

d. Space temperature controls: Provide controls including adjustable programmable thermostats with COOL-OFF-HEAT system switch and AUTO-ON fan switch. Thermostats shall be furnished by unit manufacturer. Provide relays, transformers, contactors, and control wiring between thermostats and unit. Provide controls under Section 23 09 53.00 20, "Space Temperature Control Systems." Provide controls under Section 23 09 54, "Direct Digital Control Systems."

e. Weatherproof casing: Provide removable gasketed panels designed to exclude driving rain for access to fans, coils, filters, compressors, motors, and controls. Provide weatherproof outside air intake louvers or weatherproof hoods with moisture eliminators.

f. Roof curbs: Provide factory-fabricated galvanized steel roof curbs, wood nailers, insulation, and seal strips in accordance with NRCA R&W Manual curb details for rooftop air-handling units.

Roof curbs shall be furnished by unit manufacturer.

g. Special corrosion protection: Provide heating and cooling coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

h. Equipment selection: Air-handling unit (AHU) manufacturer shall certify the capability of the AHU to perform between the cumulative design minimum and maximum airflows of the variable air volume (VAV) terminals. The AHU submittal selection shall be supported by fan curves clearly annotated showing operating points of the minimum and maximum airflow of connected VAV terminals.

2.1.6 Multizone Air-Handling Units

Provide units factory assembled, designed, tested, and rated in accordance with ARI 430. Units shall include multizone damper section, fan section, coil section, filter section, mixing box section, and access panels. Insulate inside of casing with manufacturer's standard insulation.

a. Multizone Damper Section: Dampers shall rotate in nylon bearings and shall be interconnected externally with single steel rod to permit zoning in the field. Provide solid zone partitions between the blades with neoprene gasketed stops for positive leakproof sealing of the dampers. Unit manufacturer shall furnish duct clips for attaching damper sections to ducts. Provide three-deck multizone units with two sets of independent dampers (hot/bypass and cold/bypass) per zone. The dampers shall be interlocked so that the cold deck will not open until the hot deck is completely closed. Provide two-deck multizone unit with hot deck or cold deck and bypassing air dampers positioned at 90 degrees offset from each other.

b. Fan Section: Provide blow-through centrifugal fan section including motor, starter, and drives. Provide adjustable sheaves to permit fan capacity variation from 5 percent above to 5 percent below rated capacity.

c. Coil Section: Provide separate ARI 410 hot deck water coils and cold deck water coils. Seal coils to casing to prevent air leakage around the coils. Partitions between bypass, hot deck water coils, and cold deck water coils shall be factory insulated. Provide insulated drain pan under cooling coils and valves. Balance pressure drops through the hot deck, cold deck, and bypass with factory installed equalizing baffles.

d. Filter Section: Provide UL listed throwaway 1 inch thick fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity. Provide gasketed hinged access panel with quick opening half-twist latches at end of filter rack. Filter rack shall accept 2 inch thick filters.

e. Space Temperature Controls: Provide controls under Section 23 09 53.00 20, "Space Temperature Control System." Provide controls under Section 23 09 54, "Direct Digital Control Systems."

2.1.7 Air-Cooled Water Chillers

Provide single package units factory assembled, designed, tested, and rated in accordance with ARI 590 with air-cooled condensers. Provide not less than two independent refrigerant circuits for multicompressor units. Provide direct expansion shell and tube design, refrigerant circuits, including electric-motor-driven refrigerant compressors with integral crankcase heater, air-cooled condenser, receiver, chiller, piping, controls, and accessories mounted in a cabinet. Provide refrigerant, internal pressure relief device, solenoid valve, combination liquid-line strainer-drier, expansion valve, and service valves. Condenser discharge air shall be in vertical direction. Provide guards to protect condenser fins from mechanical damage. Provide equipment guards around base of unit. Crankcase heaters are not required when scroll compressors are provided.

a. Controls: Provide factory-wired digital electronic controls including adjustable programmable thermostat for chilled water temperature control, high-low pressure control, low water temperature safety thermostat, ON-OFF unit switch, and nonrecycling pump-down relay. Controls shall also include maximum operating pressure expansion valves and programming of microprocessor chiller controls or high temperature controller for operation of compressors in cool down mode for start-up or changeover when entering water temperature is in 60 to 90 degree F range. Provide electrical interlock between water chiller and chilled water pump to prevent chiller from operating unless pump is running. Provide flow switch or flow sensors in chilled water return piping to stop compressor in event of water flow failure. Condenser fan electric motors shall be drip-proof, with built-in three-phase overload protection, mounted inside the casing. Compressor motor stoppage due to thermal and pressure overload shall require manual restart. Provide control and interlock wiring. Provide thermostat controlled electric heater cable around chiller and exterior piping for freeze protection down to 0 degree F air temperature, to operate when ambient exterior air temperature falls below 40 degrees F. Provide low ambient control to 40 degrees F _____ degrees F and hot-gas bypass.

b. Weatherproof casing: Provide removable gasketed panels designed to exclude driving rain for access to compressors, motors, and controls.

c. Special corrosion protection: Provide condenser coils with copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

2.1.8 Air-Cooled Condensing Units

Provide units factory assembled, designed, tested, and rated in accordance with ARI 365. Units shall be ARI certified. Provide units including electric-motor-driven refrigerant compressors with integral crankcase heater, air-cooled condenser, with refrigerant and holding charge of dry nitrogen and seal. Provide isolation and service valves at refrigerant piping connections to unit. Provide refrigerant, pressure relief valve,

solenoid valve, combination filter-dryer, and expansion valves. Condenser discharge air shall be in vertical direction. Provide guards to protect fins from mechanical damage. Provide extension tubing to exterior of unit casing for each lubrication fitting. Provide field adjustable head pressure controls to maintain a minimum head pressure corresponding to 90 degrees F condensing temperature when ambient temperature is 40- degrees F. Crankcase heaters are not required when scroll compressors are provided. Unit shall be manufactured by same manufacturer as the air handling unit.

a. Controls: Provide factory controls including automatic safety shutdown switches for each compressor for the following hazardous system conditions: refrigerant high pressure, refrigerant low pressure, low oil level, and compressor overload. The switches shall be located in the unit control panel. The cutout switches shall automatically stop the respective compressors and simultaneously ring an alarm bell whenever the pressure within the condenser rises above the predetermined safe point. Provide adjustable automatic hot-gas bypass regulator valve, external equalizer tubing, and interconnecting tubing. Field adjust as required after charging. Hot-gas bypass shall be factory fabricated requiring only field connection of factory furnished components.

b. Weatherproof casing: Provide removable gasketed panels designed to exclude driving rain for access to fans, coils, filters, compressors, motors, and controls.

c. Special corrosion protection: Provide condenser coils with copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

2.1.9 Room Fan-Coil Air-Conditioners

Provide units factory assembled, designed, tested, and rated in accordance with ARI 440. Units shall be ARI certified or listed in ARI DCAACP for cooling. Units shall include single hot water and chilled water coil, double width centrifugal fans, three-speed split capacitor motors with integral thermal overload protection, insulated drain pans under cooling coils and valves, and filters. Insulate interior of casing with manufacturer's standard insulation.

a. Filters: Provide UL listed throwaway fiberglass filters, standard dust-holding capacity.

b. Space temperature controls: Provide controls including adjustable temperature control thermostats with COOL-OFF-HEAT system switch, HIGH-MEDIUM-LOW fan switch, and FAN ONLY switch. When system switch is in OFF position, de-energize automatic valve to stop water flow to coil. Thermostats shall be furnished by unit manufacturer. Provide relays, transformers, contactors, and control wiring between thermostats and unit. Provide controls under Section 23 09 53.00 20, "Space Temperature Control System."

c. Horizontal units:

(1) Concealed units: Provide unit mounted filter box with track and hinged access doors with latches. Provide supply air discharge with one inch duct collar. Provide return air plenum suitable for bottom or rear return air duct connection as indicated. Provide plenum with duct lining.

(2) Recessed units: Provide adjustable recessing frame for flush ceiling mounting. Provide hinged bottom panel with latches for access to filters and fan motors. Provide discharge air outlet with one inch duct collar. Provide bottom access panel with stamped return air grille or provide solid bottom access panel and rear return air inlet with one-inch duct collar as indicated.

(3) Cabinet units: Provide hinged bottom panel with latches for access to filters and fan motors. Provide adjustable double deflection or stamped discharge grilles as indicated. Provide bottom or rear stamped return air grille as indicated.

d. Vertical units: Provide concealed, recessed, and cabinet units where indicated. Provide unit levelers, subbases, and removable front cover for access to filters and fan motors. Provide outside air intake boxes with automatic dampers set for cfm indicated in open position and weatherproof anodized aluminum louvers.

(1) Recessed unit: Provide removable front cover for access to entire unit. Provide discharge air and return air grilles in front cover. Provide top discharge air outlet with one-inch duct collar.

(2) Cabinet unit: Provide removable front, side, and top panels. Provide adjustable double deflection or stamped discharge grille as indicated.

2.1.10 Room Air-Conditioners

Provide units factory assembled, cooling capacity rating tested, and electrical input rating tested in accordance with AHAM Directory. Units shall be AHAM certified or listed in AHAM Directory. Provide window air-conditioning units and special wall sleeve suitable for through-the-wall installation of units; do not restrict louvers or cabinet sides. Provide wall sleeves designed to exclude driving rain. Provide installation hardware as recommended by unit manufacturer. Unit chassis shall be removable from inside building without removing cabinet. Provide guards to protect condenser fins from damage. Provide permanent washable air filters, removable without use of tools.

a. Space temperature controls: Provide OFF-HIGH-MEDIUM-LOW cooling fan switch, and COOLER-WARMER adjustable temperature control thermostat. Provide fresh air open and closed switch.

b. Power cord: Provide manufacturer's standard length three-wire grounding cord and plug.

2.1.11 Packaged Terminal Air-Conditioners

Provide units factory assembled, designed, tested, and rated in accordance with ARI 310/380 for cooling. Units shall be ARI certified or rated in ARI DCAACP for cooling. Units shall include refrigeration section,

heating section (where indicated), separate outdoor weatherproof louvers, forced ventilation, room cabinet, fans and motors, controls, wall sleeves, filters, dampers, grilles, subbases, leveling device, and power connections. Wall sleeves and installation shall be designed to exclude driving rain. Insulate interior of unit with manufacturer's standard insulation. Unit shall have slide-out chassis easily removed through room cabinet opening. Provide adjustable deflection inside air supply grille. Fan motors shall be permanent-split capacitor type. Provide wall mounted units minimum of 3-inches above floor unless floor mounted units are indicated. Provide factory supplied ducts and air baffles to direct discharge air to adjoining room where indicated.

a. Filters: Provide permanent washable air filters or UL rated throwaway fiberglass filters, standard dust-holding capacity; removable through access door or panel.

b. Safety controls: Provide compressor motors with thermal and overload protection, 5 minute anti-recycle timer, start capacitor kit, and crankcase heater. The above safety controls are not required when scroll compressors are provided.

c. Heating section: Provide UL listed electric resistance heaters including internal fusing integral with heaters; fan shall run until heater cools. Provide ARI 410 hot water coils.

d. Space temperature controls: Provide controls including COOLER-WARMER adjustable temperature control thermostat with COOL-OFF-HEAT system switch and HIGH-MEDIUM-LOW fan switch, and FAN ONLY switch.

e. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after to application of phenolic coating.

2.1.12 Packaged Terminal Heat Pumps

Provide units factory assembled, designed, tested, and rated in accordance with ARI 310/380. Units shall be ARI certified or rated in ARI DCAACP. Units shall include refrigeration section, additional heating section (where indicated), separate outdoor weatherproof anodized aluminum louvers, forced ventilation, room cabinet, fans and motors, controls, wall sleeves, filters, dampers, grilles, subbases, leveling device, and power connections. Wall sleeves and installation shall be designed to exclude driving rain. Insulate interior of unit with manufacturer's standard insulation. Unit shall have slide-out chassis easily removed through room cabinet opening. Provide adjustable deflection inside air supply grille. Fan motors shall be permanent-split capacitor type. Provide wall mounted units minimum of 3-inches above floor unless floor mounted units are indicated. Provide factory supplied ducts air baffles to direct discharge air to adjoining room where indicated.

a. Filters: Provide permanent washable air filters or UL listed throwaway fiberglass filters, standard dust-holding capacity; removable through access door or panel.

b. Safety controls: Provide compressor motors with thermal and

overload protection, 5 minute anti-recycle timer, start capacitor kit, and crankcase heater. The above safety controls are not required when scroll compressors are provided.

c. Supplemental heating section: Provide UL listed electric resistance heaters including internal fusing integral with unit; fan shall run until heater cools. Provide controls to operate heater only when indoor thermostat is in heating mode and outdoor thermostat indicates outside temperature is below 35 degrees F or unit balance point, whichever is higher; and when unit is in defrost mode at any outside temperature.

d. Space temperature controls: Provide controls including adjustable COOLER-WARMER temperature control thermostats with COOL-OFF-HEAT system switch and HIGH-MEDIUM-LOW fan switch, and FAN ONLY switch.

e. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

2.1.13 Computer Room Air-Conditioners

Provide units self-contained, factory assembled, designed, tested, and rated in accordance with ARI standards. Unit shall be listed in UL Elec Equip Dir for computer room application. Provide unit with air-cooled condenser, water-cooled condenser, or glycol cooled condenser as indicated. Unit shall include room cabinet and frame, fan section, filter section, cooling coil, reheat coil, humidifier, compressors, condensers, interconnecting piping, and controls. Provide cabinet with manufacturer's standard finish. Insulate interior of unit with manufacturer's standard insulation. Provide removable panel for access to controls without interrupting airflow.

a. Filters: Provide UL listed deep pleated fiberglass filters with 30 percent efficiency based on ASHRAE 52.

b. Humidifier: Provide infrared type humidifier, including high intensity quartz lamps mounted above and out of water supply, stainless steel evaporator pan prepiped with water level controls and alarms. Arrange system to be cleanable and serviceable. Furnish one extra lamp. Provide electric immersion type humidifier. Provide entire assembly and removable pan of stainless steel construction. Protect elements with high temperature limit cutout. Provide steam generator type humidifier. Controls shall include water level control, steam generation, and flush cycle. Humidifier section shall include liquid-level control and emergency overflow and shall be prepiped with an automatic water supply system for final connection.

c. Cooling coil: Provide coil constructed of copper tubes with plate aluminum fins. The condensate drain pan shall be stainless steel construction with nonferrous connections and internal trap. Provide condensate pump complete with integral float switch, reservoir, and pump and motor assembly.

d. Reheat coil: Provide hot gas, steam, hot water, reheat coil

constructed of copper tubes with plate aluminum fins. Provide UL listed electric reheat coil with enclosed, finned tube heating elements with UL listed safety switches to protect system from overheating.

e. Refrigeration system: Provide compressors complete with vibration isolation, suction and discharge service valves, high and low pressure safety switches, and built-in overload protection. Provide refrigeration circuits including hot gas mufflers, liquid-line filter-drier, refrigerant sight glass and moisture indicator, externally equalized expansion valve, and liquid-line solenoid valve factory connected with refrigeration copper tubing. Crankcase heaters are not required when scroll compressors are provided.

f. Space temperature controls: Provide microprocessor control system integral with unit including electronic control center, control valves, sensors, wiring, and other appurtenances for workable system. Provide access panel or door in front of unit. Isolate electronic control center from conditioned airstream to allow service while system is in operation. Provide control sensors in unit for cooling, dehumidifying, and humidifying. High-voltage circuits in system shall have individual leg overload protection. Starters, contactors, and relays shall be controlled by 24-volt control circuit. High-voltage circuit components shall be protected by safety lock, dead-front panel. Mount nonautomatic, molded-case circuit breaker in high-voltage section of electrical panel. Operating mechanism shall prevent access to high-voltage electrical components until switched to "OFF" position.

g. Alarm panel: Provide unit with cabinet-mounted alarm panel which shall monitor high and low space temperature, high and low space humidity, dirty filters, loss of airflow, compressor high head pressure, field accessible local alarm, and humidifier problems. Provide underfloor water detector. Provide audible alarm.

h. Condenser: Provide remote air-cooled condenser arranged for vertical air discharge. Provide winter control system to maintain head pressure in ambient temperature as low as minus 20 degrees F. Provide cleanable, shell and tube, counterflow type water-cooled, glycol-cooled, condenser with removable heads. The condenser shall be constructed in accordance with ASME BPV I. Condenser circuit shall be prepiped with two-way regulating valve actuated by head pressure, head pressure activated regulating valve and parallel bypass valve.

i. Dry coolers: Provide unit with centrifugal pump, mounted in weatherproof and vented enclosure. Provide factory-assembled unit with vertical air discharge. Performance shall meet requirements for heat removal capacity, coolant flow rate (water or percent ethylene glycol), maximum coolant pressure loss through unit design ambient temperature, and elevation above sea level. Unit shall be constructed as integral unit complete with supporting frame, cooling core, fans and fan drives, and suitable guards. The cooling core shall be constructed of copper or aluminum tubes with aluminum fins and removable manifold tanks.

j. Special corrosion protection: Provide condenser coils constructed of copper tubes and plate copper fins or copper tubes and plate

aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film thickness. Rating of units shall be after application of phenolic coating.

2.1.14 Series Fan Powered Variable Air Volume (VAV) Terminals

Provide units factory assembled, designed, tested, and rated in accordance with ARI 880. Units shall be ARI certified and listed in the ARI APD. Units shall provide a supply air discharge mix by modulation of conditioned primary air and recirculating of return air. Units shall include casing, centrifugal fan and motor, primary VAV damper or valve, pneumatic, electric, electronic, volume regulator, discharge air damper, primary air inlet cone with high and low pressure flow sensors, recirculating air filter frames, filter, and electrical disconnect. Provide hot water heating coils.

a. Casing: Provide removable full bottom access panels for servicing internal components without disturbing duct connections. Insulate inside of casing with manufacturer's standard insulation. Units shall have recirculating air inlet equipped with filter frame, round primary damper or valve, and unit mounting brackets.

b. Fans and motors: Provide centrifugal, forward curved, multiblade, fan wheels with direct-drive motors. Motors shall be high efficiency permanent-split capacitor type with thermal overload protection and permanently lubricated bearings. Motors shall have three speeds or be equipped with solid state speed controllers. Provide isolation between fan motor assembly and unit casing. Fan and motor shall be removable through casing access panel.

c. Flow sensor: Sensor shall be ring or cross type with minimum of two pickup points which average the velocity across the inlet. Flow measurement shall be within plus or minus 5 percent of rated airflow with 1.5 diameters of straight duct upstream of unit and inlet static variation of 0.5 to 5.0 inches W.G. Flow measuring taps and calibration flow chart shall be supplied with each unit for field balancing airflows.

d. Primary VAV damper or valve: Galvanized steel damper blade shall close against gasket inside unit. Connect damper to operating shaft with a positive mechanical connection. Provide nylon bearing for damper shaft. Cylindrical die cast aluminum valve inlet tapered to fit round flexible ducts with integral flow diffuser and beveled self-centering disc. Damper or valve leakage at shutoff shall not exceed 2 percent of capacity at 1-inch W.G. pressure.

e. Regulator: Volume regulator shall be electronic. Electronic controls contained in NEMA ICS 6, pneumatic, electric, Type 1 enclosure sealed from airflow. Controls shall be mounted on side of unit or on air valve. System powered regulators shall not be permitted. Volume regulator shall reset primary air volume as determined by thermostat, within upstream static pressure variation noted in paragraph entitled "Flow Sensor." Volume regulators shall be field adjustable and factory set and calibrated to indicated maximum and minimum primary airflows. Volume regulators shall be direct acting and normally open, closed upon loss of power or pneumatic pressure.

f. Electrical: Unit shall incorporate single point electrical connection with electrical disconnect. Electrical components shall be UL listed and installed in accordance with NFPA 70. Electrical components shall be mounted in control box. Units UL listed as an assembly do not require airflow switch interlock with electric heating coil when factory assembled.

g. Filters: Provide UL listed throwaway one-inch thick fiberglass filters, standard dust-holding capacity.

2.1.15 Water-Source Heat Pumps

Provide units factory assembled, designed, tested, and rated in accordance with ARI 320. Units shall be ARI certified or listed in ARI directory. Units shall include fans, evaporator coil, filters, dampers, compressor, refrigerant to water heat exchangers, and controls. Insulate interior of casing with manufacturer's standard insulation. Unit shall be listed in UL Elec Equip Dir. Provide additional heating section when indicated.

a. Filter section: Provide permanent washable air filters or UL listed throwaway fiberglass filters, standard dust-holding capacity, removable through access door or panel.

b. Safety controls: Provide compressor motor with thermal and overload protection, 5 minute anti-recycle timer, and start capacitor kit. Provide compressor with electrical crankcase heater and internal high pressure protection. The above safety controls are not required when scroll compressors are provided. Provide low water temperature and low water pressure cutout protection.

c. Supplemental heating section : Provide UL listed electric resistance heaters including internal fusing integral with indoor unit; fan shall run until heater cools. Locate downstream of indoor coil. Provide controls to operate heater only when indoor thermostat is in second stage of heating mode.

d. Space temperature controls: Provide controls including adjustable thermostats with COOL-OFF-HEAT system switch and AUTO-ON fan switch. Thermostats shall be furnished by unit manufacturer. Provide relays, transformers, contactors, and control wiring between thermostats and unit.

2.1.16 Liquid Cooling Radiators

Provide factory-assembled unit with vertical air discharge. Performance shall meet requirements for heat removal capacity, coolant flow rate (water or percent ethylene glycol), maximum coolant pressure loss through unit, design ambient temperature, and elevation above sea level. Unit shall be complete with supporting frame, cooling core, fans, fan drives, and guards. The cooling core shall be constructed of copper tubes with plate aluminum fins and removable manifold tanks.

a. Special corrosion protection: Provide cooling core constructed of copper tubes and plate copper fins or copper tubes and plate aluminum fins with phenolic coating factory applied to entire coil by immersion dipping and baking to 1.5 mil minimum dry film

thickness. Rating of units shall be after application of phenolic coating.

2.1.17 Cabinet Unit Heaters

Provide units factory assembled, designed, and tested. Units shall include single heating hot water, steam coil,, centrifugal fans, three-speed split capacitor motors with integral thermal overload protection, and filters.

a. Filters: Provide UL listed throwaway fiberglass filters, standard dust-holding capacity.

b. Space temperature controls: Provide controls including adjustable room temperature control thermostats with VENT-OFF-HEAT system switch, HIGH-MEDIUM-LOW fan switch, and FAN ONLY switch. When system switch is in OFF position, de-energize automatic valve to stop water flow to coil. Thermostats shall be furnished by unit manufacturer and installed where indicated. Provide relays, transformers, contactors, and control wiring between thermostats, and unit. Provide controls under Section 23 09 53.00 20, "Space Temperature Control Systems." Provide controls under Section 23 09 54, "Direct Digital Control Systems."

c. Horizontal units: Provide concealed, recessed, and cabinet units where indicated.

(1) Concealed Units: Provide unit mounted filter box with track and hinged access doors with latches. Provide supply air discharge with one-inch duct collar. Provide return air plenum suitable for bottom or rear return air duct connection as indicated. Provide plenum with duct lining.

(2) Recessed units: Provide adjustable recessing frame for flush ceiling mounting. Provide hinged bottom panel with latches for access to filters and fan motors. Provide discharge air outlet with one-inch duct collar. Provide bottom access panel with stamped return air grille or provide solid bottom access panel and rear return air inlet with one-inch duct collar as indicated.

(3) Cabinet units: Provide hinged bottom panel with latches for access to filters and fan motors. Provide adjustable double deflection or stamped discharge grilles as indicated. Provide bottom or rear stamped return air grille as indicated.

d. Vertical units: Provide recessed and cabinet units where indicated. Provide unit levelers, subbases, and removable front cover for access to filters and fan motors. Provide outside air intake boxes with manual dampers, automatic, and weatherproof anodized aluminum louvers.

(1) Recessed unit: Provide removable front cover for access to entire unit. Provide discharge air and return air grilles in front cover.

(2) Cabinet unit: Provide removable front, side, and top panels. Provide adjustable double deflection or stamped discharge grille as indicated.

2.1.18 Unit Heaters

Provide factory-assembled, propeller or blower type fan unit heaters arranged for horizontal or vertical air discharge as indicated. Each unit shall include steam, hot water, coil, fan, electric motor, housing, and air discharge vanes or diffusers. Horizontal discharge type units shall have adjustable deflectors for control of horizontal and vertical airflow. Rotating air deflector assemblies on vertical units where indicated shall be gear driven by separate electric motor and shall rotate when the fan runs. Each unit shall be provided with threaded mounting holes for attaching threaded hanger rods. Fan motor shall be controlled by wall-mounted adjustable thermostat with higher end of scale range factory set at 75 degrees F. Controls shall be automatic of the on-off type. Provide fan selector switches to provide AUTOMATIC-ON-OFF positions.

2.1.19 Convectors

Provide factory-assembled units including copper-alloy hot water, steam, heating coil with plate aluminum fins, nonrecessed wall-mounted baseboard type, baked enamel finish enclosure with tamperproof access doors for valve and trap. Provide copper alloy hot water valves with integral temperature sensing, single temperature sensing control element, packing gland type, for automatic thermostatic control of individual convector.

2.1.20 Finned Tube Radiation

Provide factory-assembled units including heating coil with plate fins. Hanger brackets shall have vertical adjustment for pitch of piping and shall have provisions for noiseless operation during expansion and contraction of piping. Enclosure and end caps shall be constructed of steel with baked enamel finish. Provide face operated manual dampers. Provide tamperproof access doors in enclosure for valve and traps. Provide copper alloy hot water valves with integral temperature sensing, single temperature sensing control element, packing gland type, for automatic thermostatic control of individual radiation.

2.1.21 Hot Water Converters

Provide factory-assembled, U-tube units constructed for minimum of 125 psig working pressure with steam in the shell and water in the tubes. Construct in accordance with ASME BPV I.

2.1.22 Oil-Fired Heating Boilers

Provide units factory assembled, self-contained low pressure boiler, suitable for 15 psig steam 30 psig hot water. Units shall conform to UL 726 and as specified herein. Provide integral draft fan having adequate capacity for the boiler as installed. Use of tubulators or other devices inside the tubes will not be permitted. Provide automatic water feeding device for maintaining proper water level. Provide breeching from boiler to stack. Boiler, burners, breeching, fuel oil tanks, and piping shall conform to NFPA 31 for installation.

a. Burners: UL 296, integral burner with cadmium cell flame retention, Grade No. 2 fuel oil. Burners shall be specifically designed for the boiler furnished.

b. Tankless domestic water heater: Provide as part of boiler for

intended service. Provide heater with water temperature-regulating valve and controls.

c. Boiler breeching and stack: Provide size as recommended by boiler manufacturer or as indicated. Provide prefabricated all-fuel multi-wall type UL listed for oil-fired boilers.

d. Fuel systems: Fuel oil piping shall be steel piping, except fuel oil supply and return piping may be copper tubing with flared fittings or compression type fittings.

e. Fuel oil valves: Provide valves with threaded end connections or compression type end connections.

(1) Gate valves and check valves: MSS SP-80, Class 125.

(2) Angle check valves: Double poppet with metal-to-metal seat, cast-iron body, bronze poppets and seats, Buna-N O-rings, and brass screen.

f. Underground fuel oil storage tank: ASTM D 4021 and UL 1316, double-wall glass fiber reinforced polyester tank. Provide automatic electronic, manual leak monitoring and fuel level system. Provide tank with whistle vent alarm.

g. Aboveground fuel oil storage tank: UL 142 welded steel tank.

2.1.23 Pumps

a. In-Line pumps: Provide pumps constructed of manufacturer's standard materials suitable for chilled water and hot water heating systems. Pumps shall have mechanical seals and drip-proof electric motors.

b. End suction water pumps: Pumps shall be single stage centrifugal, with mechanical seals and drip-proof electric motors. Impeller shall be bronze. Other pump parts shall be manufacturer's standard materials provided with bronze impeller pump. Provide threaded suction and discharge pressure gage tapping with square-head plugs. Provide flexible coupling with steel cover guard on base-mounted pumps. Base-mounted pump, coupling guard, and motor shall each be bolted to a fabricated steel base which shall have bolt holes for securing base to supporting surface. Close-coupled pump shall be provided with integrally cast or fabricated steel feet with bolt holes for securing feet to supporting surface.

c. Pump suction diffuser: Casing shall include an angle type body of cast iron. Unit shall have internal straightening vanes, strainer with minimum 0.25-inch openings, and auxiliary disposable fine mesh strainer which shall be removed 30 days after start-up. Provide warning tag for operator indicating scheduled date for removal. Casing shall have connection sizes to match pump suction and pipe sizes, and be provided with adjustable support foot or support foot boss to relieve piping strains at pump suction. Blowdown port and plug shall be provided on unit casing. Provide a magnetic insert to remove debris from system.

2.1.24 Exhaust Fans

AMCA 210 with AMCA seal. Provide centrifugal type exhaust fans with aluminum housing, fan wheel, and bird screen. Motors shall be completely shielded from the airstream. Provide exhaust opening and gravity closing type automatic backdraft dampers. Provide NRCA R&W Manual roof curb for roof mounted exhaust fans as recommended by fan manufacturer.

2.1.25 Direct Vent Gas-Fired Central Furnaces

Provide ANSI Z21.64 factory assembled, self-contained, forced circulation, LP gas-fired air heating, direct vent (condensing) central furnaces with direct vent sealed combustion system using 100 percent outdoor air, and designed to distribute air through ducts for space heating and cooling. Provide electronic pilot ignition system. Unit shall be factory wired with both cooling and heating controls. Unit shall be design certified by American Gas Association, GAMA efficiency rating certified, and listed for gas central furnaces. Minimum AFUE shall be 90 percent. Provide UL listed throwaway one-inch thick fiberglass filter in return air to each unit. Provide 20- to 30-volt digital heating and cooling, space temperature control thermostat with manual changeover. Provide LP gas steel piping, PVC vent and combustion air piping, and PVC condensate drain piping sized as recommended by furnace manufacturer. Provide cooling (evaporator) coil units and cabinets suitable for use with furnace and as specified in paragraph entitled "Split-System Air-Conditioners."

2.1.26 Ceiling Hugger Stem Type Fans

UL 507 and UL listed ceiling hugger, stem type fans for close-to-ceiling installation, minimum of four 52 inch diameter fan blades, 3 speed pull chain fan motor switch, reversing switch, and light kit adaptable. Provide special fan support including metal electrical ceiling outlet box designed to support the weight of the fan and light assembly, and to prevent fan wobbling and vibrating at all fan speeds. Secure fan support with minimum of 2 metal hex head screws for each connection. Provide white opal glass schoolhouse type globe light kit to match fan.

2.1.27 Bathroom Exhaust Fans

UL 507 and UL listed for ceiling installation, HVI (Home Ventilating Institute) certified, with AMCA seal. Unit shall be 2.5 zones or less at rated cfm and static pressure.

2.1.28 Range Hoods

UL 507 and UL listed, with AMCA seal, separately switched 2 speed exhaust fan and lights. Fan capacity shall be 160 cfm with maximum sound level of 5.6 zones. Provide 30 inch stainless steel range hood with easily removable washable metal filter and zinc-coated steel ducts to exterior of building with weatherproof grille.

2.1.29 Energy Recovery Ventilator

Unit shall include outdoor supply fan, exhaust aire fan, recovery wheel, 2-inch thick outdoor air and exhaust air filters, and outdoor and exhaust shut off dampers.

2.1.29.1 Exhaust Discharge and Outside Air Intake

Exhaust discharge and outside air intake shall not be located on the same side on roof top units. Units shall be UL listed and bear the UL label. Energy transfer ratings shall be in accordance with ASHRAE Standard 84. Performance to be as scheduledc on plans. Unit casing to be insulated with 1-inch 3# rigid board fiberglass with fire-resistant Foil-Scrim-Kraft facing. All componenets shall be easily accessible throught removable access doors for both exhaust and supply compartments.

2.1.29.2 Energy Recovery Wheel

Energy recovery wheel shall be in cassette form mounted on slide out track and include a total energy recovery wheel for sensible and latent energy recovery, wheel drive motor with permanently sealed ball bearings and electrical disconnect. The total enthalpy wheel shall be constructed of a light weight polymer material in removable sections with a permanently bonded silica gel desiccant coating. The unit shall not require a condensation pan. Sensible only energy recovery devices are not acceptable.

2.1.29.3 Exterior Installations

Unit shal lbe of internal frame type construction of G90 galvanized steel. All panels exposed to the weather shall be a minumum of 20 gauge galvanized steel. Where top panels are joined there shall be a standing seam to insure peositive weather protection. Provide weather hoods of the same finishe as the unit. Supply weather hood shall be louvered to stop wind driven rain and incorporate a moisture eliminator and bird screen. Exhaust hood shall include an automatic back draft damper and bird screen.

2.2 ELECTRICAL

2.2.1 Electrical Motors, Controllers, Contactors, and Disconnects

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to Section 26 20 00, "Interior Wiring Systems." Provide electrical connections under Section, 26 20 00, "Interior Wiring Systems." Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

2.2.2 Electrical Work

Provide under Section 26 20 00, "Interior Wiring Systems." Provide control wiring under Section 23 09 53.00 20, "Space Temperature Control Systems." Provide control wiring under Section 23 09 54, "Direct Digital Control Systems." Provide control wiring under this section in accordance with NFPA 70.

2.3 METAL DUCT SYSTEMS

Provide shop-fabricated, zinc-coated steel ducts conforming to ASTM A 525 or ASTM A 653/A 653M coating designation G60. Fabricate, construct, brace, reinforce, install, support, and seal ducts and accessories, and test ducts in accordance with SMACNA HVAC Duct Const Stds and SMACNA Leakage Test Mn1. Cover duct transverse joints with single component synthetic rubber type compound suitable for use with passivated

coating on zinc-coated steel. Lap joints in direction of flow. Provide ducts straight and smooth on inside with neatly finished airtight joints. Provide air supply and return openings in ducts with air diffusers, registers, or grilles.

2.3.1 Flexible Duct Connectors

Provide airtight flexible duct connectors at duct connections to each air-conditioning unit, air-handling unit, exhaust fan, and ventilating fan. Support connectors at each end with metal angle frame bands, securely bolt in place. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene.

2.3.2 Turning Vanes

Provide fabricated tees and square elbows with turning vanes in accordance with SMACNA HVAC Duct Const Stds for vanned elbows. Turning vanes shall be single wall with trailing edges.

2.3.3 Dampers

Provide factory manufactured opposed blade adjustable manual dampers where indicated for duct heights of 12 inches and larger. Provide factory manufactured single leaf dampers for duct heights less than 12 inches. Provide damper shafts with 2 inch standoffs to clear 2 inches of duct insulation with bearings at both ends of the shafts. Provide adjustment quadrant with indicator and locking devices. Provide galvanized steel dampers one gage heavier than duct in which dampers are installed. Provide automatic dampers under Section 23 09 53.00 20, "Space Temperature Control Systems." Provide automatic dampers under Section 23 09 54, "Direct Digital Control Systems."

2.3.4 Diffusers, Registers, and Grilles

Provide factory-fabricated metal units with edges rolled or rounded where exposed to view, and factory primed with white enamel finish. Provide each diffuser and register with factory-fabricated, group-operated, adjustable, opposed-blade, air-volume-control dampers, key or screwdriver operated from the face of unit without the use of a tool. Provide each unit with rubber or plastic installation gaskets. Diffusers in same room shall have same face design.

a. Diffusers: Provide round, square, or rectangular diffusers as indicated. Ceiling diffusers shall be designed to deliver air in a horizontal direction. Provide baffles or other devices as required for proper air distribution pattern.

b. Registers: Provide double deflection supply registers arranged to control air direction, throw, and drop. Exhaust and return air registers shall have single set of nondirectional face bars or vanes having the same appearance as supply registers. Provide face bars or vanes spaced not more than 0.75 inch on center and not less than 0.62 inch depth.

c. Grilles: Provide as specified for registers without air-volume-control dampers.

2.3.5 Outside Air Intake Louvers

Louvers shall bear AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500. Maximum pressure drop shall be 0.1 inch WG, unless indicated otherwise. Louvers shall have maximum water penetration of 0.20 ounce per square foot of free area at free velocity of 800 fpm. Provide aluminum alloy with anodized finish frames and blades assembled with stainless steel screws, including 0.5-inch mesh aluminum screen mounted in extruded aluminum frame. Louvers are specified in Section 08 91 00, "Metal Wall and Door Louvers."

2.3.6 Access Doors

Provide for access to volume dampers, fire dampers, plenum chambers, and where indicated. Provide each door with double wall zinc-coated steel construction, gasketed airtight, with continuous hinges and cam latches. Insulate access doors with one-inch thick rigid insulation. Provide 12 inch by 12 inch door, except where larger sizes are indicated, or provide 12 inches by height of duct when duct is less than 12 inches high. Provide keyed-alike 90 degree turn cam locks on each access door in sleeping rooms; furnish three keys.

2.3.7 Fire Dampers

UL 555 and NFPA 90A. Dampers shall be listed inUL Bld Mat Dir. Dampers when open shall not protrude into the ducts.

2.3.8 Duct Heaters

ARI 410, steam, hot water, coils. Electric heating coils shall have aluminized steel flanged frame for duct mounting, complete with terminal box, high limit thermal cutout bulb, and open resistance type heating elements. Coils shall have an airflow switch to keep heaters from operating with no-airflow. Provide controls to keep fan running until heater cools. Provide wire type heating elements insulated from metal by ceramic bushings. Provide UL listed or FM approved duct heaters.

2.3.9 Filter Boxes

Provide when filters are not provided integral with the air-conditioning units or air-handling units. Construct filter boxes of zinc-coated steel with track, hinged access doors with latches, seal gaskets between frame, and filters. Arrange filters to filter outside air intake and return air. Filter assemblies shall be removable from filter box and replaceable without use of tools. Replaceable filter rack shall be designed to accept 2 inch thick filters.

a. Replaceable filters: Provide UL listed throwaway 1 inch thick fiberglass filters, standard dust-holding capacity, 350 fpm maximum face velocity.

b. High efficiency filters: Provide UL Class 2, mean efficiency of 30 percent when tested in accordance with ASHRAE 52. Filter assembly shall include holding frame and fastener assembly, filter cartridge, and mounting frame and retainer assembly. High efficiency filters shall be preceded by replaceable filter.

2.3.10 Flexible Round Ducts

UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Fire hazard rating of duct assembly shall not exceed 25 for flame spread and 50 for smoke developed. Provide ducts designed for working pressures of 2 inches W.G. positive and 1.5 inches W.G. negative. Flexible round duct length shall not exceed 5 feet. Secure connections by applying adhesive for 2 inches over rigid duct, apply flexible duct 2 inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

a. Inner duct core: Flexible core shall be interlocking spiral or helically corrugated and constructed of zinc-coated steel, aluminum, or stainless steel; or shall be constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

b. Insulation: Inner duct core shall be insulated with mineral fiber blanket type flexible insulation, minimum of one inch thick. Insulation shall be covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.3.11 Duct Lining

Provide where indicated. Provide ASTM C 1071 fiberglass duct lining, minimum of one inch thick, with black-pigmented fire-resistant coating on side exposed to airstream. Secure to duct interior with 100 percent coverage of adhesive and with mechanical fastening devices, spaced in accordance with SMACNA HVAC Duct Const Stds. Provide metal nosing at duct lining beginnings and endings.

2.4 PIPING SYSTEMS

Provide the following pipe and fittings. Provide dielectric fittings, unions or flanges between steel piping and copper tubing for all piping sizes; except that copper alloy valves and strainers may be used without dielectric fittings, unions or flanges. Water piping sizes 4 inches and smaller shall be copper tubing. Water piping sizes larger than 4 inches shall be copper tubing or steel piping. If steel piping is provided, provide a solids-from-water separator.

2.4.1 Soldered Joint Copper Tubing

Provide ASTM B 88, Type L for aboveground piping, Type K for buried piping, with ASME B16.18 or ASME/ANSI B16.22 solder joint fittings, unions, and flanges; provide adapters as required. Provide ASTM B 42 copper pipe nipples with threaded end connections. Provide ASTM B 32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder.

2.4.2 Copper Tubing Piping Systems

Provide copper tubing for the following piping systems, except water piping sizes larger than 4 inches shall be copper tubing or steel piping.

a. Chilled water, chilled-hot water, and hot water piping.

b. Cold drain piping from drain pans.

c. Fuel oil supply and return piping with ASME/ANSI B16.26 flared fittings or compression type fittings.

2.4.3 Copper Cold Drain Piping

Provide copper tubing in accordance with paragraph entitled "Copper Tubing" for piping sizes one inch and smaller. Provide ASTM B 306 copper tubing and ASME B16.23 solder joint fittings for piping sizes larger than one inch. In lieu of copper tubing, 1.25 inch Schedule 40 polyvinyl chloride (PVC) plastic pipe, fittings, and solvent cement may be provided.

2.4.4 Copper Refrigerant Tubing

Provide ASTM B 280, cleaned, dehydrated, and sealed. Provide ASME/ANSI B16.22 solder joint refrigerant fittings and adapters. Provide silver brazing alloy solder and silver brazing alloy flux. During brazing operations bleed a small amount of dry oil-free nitrogen continuously through the refrigerant tubing. Provide ASME/ANSI B16.26 flared fittings.

2.4.5 Buried Preinsulated Water Piping

Provide under Section 33 61 14, "Exterior Buried Preinsulated Water Piping." Provide buried preinsulated water piping in conduit complete and ready for operation. Install in accordance with fabricator's published literature. Provide copper tubing for carrier piping; carrier piping sizes larger than 4 inches may be steel piping. Minimum depth of cover shall be 2 feet.

a. Factory-applied insulation: Provide polyurethane or polyisocyanate insulation, rated for not less than 250 degrees F service, completely filling the space between carrier pipe and conduit.

b. Factory-applied conduit: Provide each section of carrier pipe with insulation and conduit complete with waterproof conduit caps at both ends. Mark each section of conduit with fabricator's name, product identification, and publications to which the items conform. Provide same type of insulation and conduit material over field-insulated joints and fittings; provide waterproof shrink sleeves over field-insulated joints to overlap not less than 6 inches of each conduit section.

c. Bedding: Accurately grade trench bedding with minimum of 6 inches of sand. Backfill sand to minimum of 6 inches above and below conduit. Lay bedding to firmly support conduit along entire length.

d. Buried utility warning tape: Provide detectable tape for warning of buried piping.

2.4.6 Steel Piping Systems

Provide steel piping for the following piping systems.

a. Steam and condensate piping.

b. Fuel oil vent, and fill piping.

c. Gas piping.

2.4.6.1 Steel Pipe

Provide ASTM A 53/A 53M Type E or Type S, or ASTM A 106 steel pipe; except ASTM A 53/A 53M, Type F steel pipe may be provided for water pipe sizes larger than 4 inches and for steam pipe less than 100 psig. Provide Weight Class STD or Schedule No. 40 black steel pipe for welding end connections. Provide Weight Class XS or Schedule No. 80 black steel pipe for threaded end connections and for condensate piping.

2.4.6.2 Steel Pipe Fittings

Provide ASME B16.3 or ASME B16.11 threaded fittings, and ASME/ANSI B16.39 threaded unions. Provide ASME B16.9 buttwelding fittings of the same material and weight as the piping in which fittings are installed; provide backing rings compatible with piping materials being buttwelded. Provide ASME B16.11 socket welding fittings.

2.4.6.3 Steel Pipe Unions

Provide ASME/ANSI B16.39, Class 150, unions with threaded end connections on one side of threaded valve in steel piping systems.

2.4.6.4 Steel Pipe Flanges

Provide ASME B16.5, Class 150 welding neck flanges. Extend bolts no less than two full threads beyond the nut with the bolts tightened to the required torque.

a. Gaskets: Provide one piece factory cut gaskets suitable for the intended service. Provide full-face gaskets for flat-face flanged joints, and ring gaskets for raised-face flanged joints.

b. Bolts: Provide ASTM A 193/A 193M, Grade B7 bolts.

c. Nuts: ASTM A 194/A 194M, Grade 7.

d. Washers: Provide steel flat circular washers under bolt heads and nuts.

2.4.6.5 Direct Buried Steel Piping

Provide pipe and fittings with exterior coal tar epoxy painting system.

2.4.7 Valves

Valves shall have flanged end connections, except valves smaller than 2.5 inches may have threaded end connections with a union on one side of the valve. Solder end connections may be used for connections between copper alloy valves and copper tubing.

2.4.7.1 Gate Valves

MSS SP-80, Class 125, except sizes 2.5 inches and larger shall conform to MSS SP-70, Class 125.

2.4.7.2 Globe and Angle Valves

MSS SP-80, Class 125, except sizes 2.5 inches and larger shall conform to MSS SP-85, Class 125.

2.4.7.3 Check Valves

MSS SP-80, Class 125, swing check; except sizes 2.5 inches and larger shall conform to MSS SP-71, Class 125.

2.4.7.4 Butterfly Valves

MSS SP-67, except sizes 2.5 inches and larger shall have lugged or wafer body designed for installation between ASME Class 150 flanges. Valves shall have two-position lever handles, except when infinite position lever handles are indicated.

2.4.7.5 Ball Valves

Full port design, copper alloy body, except sizes 2.5 inches and larger shall be cast-iron body. Valves shall have two-position lever handles. Ball valves may be provided in lieu of gate valves.

2.4.7.6 Square Head Cocks

Provide copper alloy or cast-iron body with copper alloy plugs, suitable for 125 psig water working pressure.

2.4.7.7 Air Venting Valves

Provide copper alloy body valves with automatic or manual air vent as indicated.

2.4.7.8 Combination Pressure and Temperature Relief Valves

ANSI Z21.22, copper alloy body, automatic reseating, test lever, and discharge capacity based on AGA temperature steam rating.

2.4.7.9 Water Pressure Reducing Valves

ASSE 1003, copper alloy body, automatic reseating, with test lever.

2.4.7.10 Water Temperature Regulating Valves

Provide copper alloy body, direct acting, pilot operated, for the intended service.

2.4.7.11 Flow Control Balancing Valves

Copper alloy or cast iron body, copper alloy or stainless internal working parts, and integral pointer that indicates the degree of valve opening. Valves shall be suitable for 125 psig at 190 degrees F hot water. Valve shall function as a service valve when in fully closed position. Valve body shall have factory-installed tappings for differential pressure meter connections for verification of pressure differential across valve orifice. Meter connections shall have positive check valves or shutoff valves. Each valve shall have metal tag showing the gallons per minute flow for each differential pressure reading.

2.4.7.12 Automatic Flow Control Valves

Valve shall be tamperproof, factory calibrated, direct acting, automatic pressure compensating valve which limits flow rates to within range of plus or minus 10 percent accuracy, regardless of system pressure fluctuations. Select each valve for mid-range control of indicated capacity. Flow control mechanism includes self-cleaning spring loaded cut with open chambers and unobstructed flow passages. Valves shall be furnished by same manufacturer. Valve body shall have flow direction arrow. Provide strainer and union connection on inlet to valve. Copper alloy or cast-iron body, copper alloy or stainless internal working parts. Valves shall be suitable for 125 psig at 190 degrees F hot water. Valve body shall have factory-installed tappings for differential pressure meter connections for verification of pressure differential across valve orifice. Meter connections shall have positive check valves or shutoff valves.

2.4.7.13 Backflow Prevention Assemblies

Provide reduced pressure principle type backflow prevention assemblies which are approved by and has a current "Certificate of Approval" from the FCCCHR-USC. Listing of the particular make, model/design, and size in the current FCCCHR-USC will be acceptable as the required proof.

2.4.7.14 Radiator Valves

Provide packless bonnet, modulating type with a suitable position indicator, for steam service, hot water service with circulation vent.

2.4.7.15 Hot Water Radiator Valves

Provide copper alloy valve with integral temperature sensing, single temperature sensing control element, packing gland type, for automatic thermostatic control of individual hot water radiators or convectors.

2.4.7.16 Refrigerant Valves

ASME/ANSI B31.5, and shall be copper alloy. Provide valves in each system for servicing and for isolating system components in compliance with ASHRAE 15.

2.4.8 Valves for Steam 100 psig and Greater

Provide piping to and including the main steam pressure regulating valves, bypass valves, safety relief valves, and high pressure traps within each building under Section 33 63 23, "Exterior Aboveground Steam Distribution System" Section 33 63 16, "Exterior Shallow Trench Steam Distribution Systems" Section 33 63 13, "Exterior Underground Steam Distribution System" this section.

a. Gate valves, globe valves, angle valves, and check valves: ASME/ANSI B16.34, steel body, minimum of ASME Class 150. Provide swing check valves.

b. Steam pressure regulating valves: Steel body, minimum of ASME Class 150, except as modified herein. Valve seats and disc shall be of replaceable heat-treated stainless steel. Valves shall be single seated; seat tight under dead end conditions, and move to the closed position in the event of pressure failure of the operating (controlling) medium. Provide strainer in inlet from

external operating (controlling) medium. Valves shall be controlled by pilot valve with strainer at inlet from external pressure sensing piping. Valves shall be internally or externally steam traced for freeze protection. Valves shall be piston operated type or spring loaded diaphragm operated type with stainless steel springs.

c. Safety-relief valves: Minimum of ASME Class 150, with test lever. Valves shall have steel or copper alloy body. Valves shall have flanged inlet and outlet connections or threaded connections attached to threaded ASME Class 150 flanges. Valves shall be ASME rated for capacity indicated.

2.5 PIPING ACCESSORIES

2.5.1 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.5.2 Strainers

Pressure and temperature range shall be for the intended service. Provide blowoff outlet with pipe nipple, gate valve, and discharge pipe nipple. Provide stainless steel strainer element with perforations of 0.047 inch for water, 0.031 inch for steam mixed with condensate, and 0.016 inch for steam. Provide copper alloy or cast-iron body strainers in steam and condensate systems up to 100 psig. Provide steel body strainers in steam and condensate systems 100 psig and greater.

2.5.3 Traps

Provide traps of the types indicated with stainless steel internals. Pressure and temperature range shall be for the intended service. Traps for steam at 100 psig and greater shall be minimum of ASME Class 150.

2.5.4 Steam Pressure-Power Pump

Provide a pressure-powered pump operated by steam pressure which does not require any electrical energy. Body construction shall be of cast iron or steel for pumping liquids of specific gravity of .65 and above. The pump shall contain a float operated snap-acting mechanism to opern and close the steam inlet and the vent exhaust. There shall be no external seals or packing. Trim shall be stainless steel. Capacity and pressures as indicted. Provide inlet nad outlet lift type check valves, inlet strainer, and inlet and outlet gate valves. Provide vented receiver for draining condensate in open systems, inlet reservoir piping for drainage condensate in closed systems. Receiver or reservoir pipe shall be sized per manufacturer's recommendations or per ASHRAE Handbook. Pump body and operation shall have a maximum working pressure of at least 125 psig. If the working pressure is less than 150 psig, provide a n adjustable direct acting steam pressure reducing valve to regulate steam pressure, and a

pressrue saftety relief valve. Pressure reducing valve shall reduce steam pressure from 150 psi to 50 psi unless noted otherwise on the drawings. Safety relieve valve shall be sized to relieve the capacity of the reducing valve. Set pressure at 115 psig.

2.5.5 Pressure Gages

Provide single style pressure gage with 4.5-inch dial, brass or aluminum case, bronze tube, gage cock, pressure snubber, and syphon. Provide scale range for intended service.

2.5.6 Thermometers

Provide bi-metal dial type thermometers with stainless steel case, stem, and fixed thread connection; 3 inch diameter dial with glass face gasketed within the case; and accuracy within 2 percent of scale range. Provide scale range for intended service.

2.5.7 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide one-inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

2.5.7.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.5.7.2 Sleeves not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.5.8 Flexible Pipe Connectors

Provide flexible bronze or stainless steel piping connectors with single braid where indicated. Connectors shall be suitable for the intended service.

2.5.9 Sight Glass and Refrigerant Drier

ARI 710. Provide in refrigerant liquid piping.

2.5.10 Expansion Tanks

Construct of steel for minimum working pressure of 125 psig. Tank shall have polypropylene or butyl lined diaphragm which keeps the air charge separated from the water.

2.5.11 Air Separators

Provide tangential inlet and outlet connections, blowdown connections, and internal perforated stainless steel air collector tube to direct released air to automatic air vent. Construct of steel for minimum working pressure of 125 psig. Design to separate air from water and to direct released air to automatic air vent. Unit shall be of one piece cast-iron construction with internal baffles and two air chambers at top of unit; one air chamber shall have outlet to expansion tank and other air chamber shall be provided with automatic air release device. Unit shall be for minimum working pressure of 125 psig.

2.5.12 Flash Tanks

Construct of steel for minimum working pressure of 125 psig. Provide tank with vent and valved drain.

2.5.13 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.5.14 Solids-From-Water Separator

Provide tangential inlet and top outlet connections, solids centrifugal separator with collector and blowdown sections. Construct of steel for minimum working pressure of 125 psig. Provide vertical separator capable of removing solids of 75 microns and larger with specific gravity of 1.2 and greater. Provide wall or floor-mounted separator as indicated.

2.6 HEAT TAPE FOR FREEZE PROTECTION OF PIPING

Provide parallel conduction type that is composed of two copper conductors separated by conductive material and all encased in an insulating jacket. The heat tape shall be self-regulating that decreases heat output as temperature increases at each point along the length of tape. Provide voltage as indicated. Provide heat tape complete with fittings, adapters, and fittings, adapters, and other devices to connect tape to standard rigid steel conduit junction boxes, switches, or other devices as indicated. Provide tape sealants and jumper connectors up to 5-inches in length for connecting multiple runs. Provide a thermostat that activates the heat tape on drop of outside air temperature at 38 F. Thermostat shall have maximum tolerance of plus or minus 5 degrees F and maximum operating differential of 6 degrees F within temperature operating range. Wattage per foot of pipe at 50 F shall be as follows. This wattage may be achieved by spiraling the tape around the pipe.

Pipe Diameter (Inches)	1/2	3/4	1	1.25	1.5	2	3	4	6	8
Watt/Foot	2	2	2.5	2.5	3	3.5	4	6	7	8

2.6.1 Pressure/Temperature Test Ports (Plugs)

Provide solid bras test plugs where indicated. Test plug shall be capable of receiving a pressure or temperature probe 1/8-inch o.d. Dual seal core shall be rated zero leakage from vacuum to 200 psig and 0 F to 220 F. Each plug shall be extended through pipe insulation and be capped. Provide 2 ___ each, pressure gauge adapters with 1/8-inch o.d. probe, 5-inch stem pocket testing thermometers for 25 F to 125 F, and 0 F to 220 F.

2.7 ACCESS DOORS FOR VALVES

Provide factory-prefabricated and primed flush face steel access doors including steel door frame for with continuous hinges and turn-screw-operated latch. Provide door frame installation in plaster and masonry walls. Furnish doors under this section; install doors under appropriate section of this specification.

2.8 CHEMICAL FEED TANK

Construct of steel for minimum working pressure of 125 psig. Provide chemical pipe, fittings, and valves as specified for water piping. Add borate-nitrite corrosion inhibitors to initial fill water for heating and cooling water systems in concentrations of one-half ounce per gallon of system water.

2.9 PROGRAMMABLE THERMOSTATS

Provide programmable microelectonic thermostats. The thermostats shall have the following attributes:

a. Low voltage

b. Battery backup to maintain programming in the event of power failure

c. Automatic control of single stage heating and single stage cooling

d. Minimum 4 temperature settings per day, minimum of separate weekday/weekend day schedule, or 7 day schedules per week

e. Installation shall include initial programming

f. Temporary temperature override

g. Display clock

h. Display shall prompt for program modifications, or functions of buttons shall be self evident, or instructions shall be permanently mounted on inside of flip down keyboard cover. Thermostat shall be capable of being completely programmed without the use of separate instructions.

2.10 RADIO SWITCH

Provide a load management VHF FM radio controlled switch which shall stop unit compressor upon activation while air conditioning unit fan motor continues to run. Switch shall be mounted within unit control compartment or attached to condensing unit within a weatherproof enclosure, switch shall operate at 139.650 mhz and shall be 23-bit digital format compatible

with motorala protocol. Switch shall have two address/functions.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 HVAC System

Installation of HVAC system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, ASME/ANSI B31.5, NFPA 70, and in accordance with the manufacturer's recommendations.

3.1.2 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.2 PIPING

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing fittings; bushings will not be permitted. Install valves with stems horizontal or above. Provide flanges or unions at valves, traps, strainers, and connections to equipment; unions are not required in copper tubing piping systems.

a. Threaded connections: Provide Teflon pipe thread paste on male threads. Do not thread metal pipe into plastic piping.

b. Pipe hangers and supports: Provide additional pipe hangers and supports at in-line water pumps and flanged valves.

c. Piping to receive insulation: Provide temporary wood spacers between the pipe hangers and supports, and the pipe in order to properly slope the piping and establish final elevations. Provide temporary wood spacers of same thickness as insulation to be provided under Section 23 09 00, "Thermal Insulation For Mechanical Systems." Support plastic piping every 4 feet. Support metal piping as follows.

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Copper Tubing	6	7	8	8	9	10	11	12	13	14
Steel Pipe	7	8	9	10	11	12	13	14	16	17

d. Cleaning of piping: Keep interior and ends of new piping and existing piping affected by Contractor's operations, cleaned of water and foreign matter during installation by using plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and

foreign matter. Inspect piping before placing into position.

e. Demolition: Remove materials so as not to damage materials which are to remain. Replace existing work damaged by Contractor's operations with new work of same construction.

f. Tee Joints: Extracted tee joints may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to assure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.

3.3 ADJUSTMENTS

Adjust controls and equipment so as to give satisfactory operation. Adjust entire water temperature control system and place in operation so that water quantities circulated are as indicated. Air duct systems shall be adjusted and balanced so that air quantities at outlets are as indicated and so that distribution from supply outlets is free from drafts and has uniform velocity over the face of each outlet.

3.4 PUMPS

After testing, adjusting, and balancing, trim the impellers on all pumps 10 hp and greater to actual flow conditions plus 10 percent discharge head. Readjust throttling device to correct flow rate.

3.5 INSTRUCTING OPERATING PERSONNEL

Upon completion of work and at time designated by Contracting Officer, provide services of competent technician for period of not less than one ___ 8-hour working day for instruction of Government operating personnel in proper operation and maintenance of equipment.

3.6 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish steam, fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping and boiler before placing in operation. Clean equipment, piping, strainers, ducts, and filters.

3.6.1 Piping Systems Except for Refrigerant Piping

Before insulating, hydrostatically test each new piping system at not less than 188 psig; except pneumatically test fuel oil storage tank and fuel piping system at not less than 5 psig for tank and 50 psig for piping. Maintain pressure for 2 hours with no leakage or reduction in gage pressure. Obtain approval before applying insulation.

3.6.2 Refrigerant Piping

Perform following when field piping connections are provided.

a. Pressure test: Test refrigerant piping using dry, oil-free nitrogen, and prove tight at 300 psig on the high side and 150 psig on the low side. Maintain pressure for 2 hours with no leakage or reduction in gage pressure

b. Evacuation: Using high vacuum pump and certified micron gage, reduce absolute pressure on both sides of system simultaneously to 300 microns. After reaching this point charge system with proper refrigerant until pressure of zero psig is obtained. Repeat evacuation-charging procedure for two more cycles, totaling to three evacuation-charging cycles. On final evacuation, secure pump and maintain 300 microns for 2 hours before charging with required final refrigerant.

3.6.3 Air Ducts

Obtain approval before applying insulation.

3.6.4 Equipment

3.6.4.1 Field Testing

Test each item of equipment in operation for continuous period of not less than 24 hours under every condition of operation in accordance with each equipment manufacturer's recommendation. Verify that the equipment operating parameters are within limits recommended by the manufacturer.

3.6.4.2 Equipment Requiring Field Test Plans

Furnish equipment field test plans developed by each equipment manufacturer detailing recommended field test procedures for each item of equipment. Field test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment will not be acceptable. The Contracting Officer will review and approve the field test plan for each item of equipment prior to commencement of field testing of the equipment.

a. Equipment Items to Test: Equipment requiring field test plans are listed in paragraph "SD-08, Statements."

b. Coordinated Testing: Indicate in each field test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of equipment controls which interlock and interface with controls factory prewired or external controls for the equipment provided under Section 23 09 53.00 20, "Space Temperature Controls" Section 23 09 54, "Direct Digital Control Systems".

c. Prerequisite Testing: Equipment for which performance testing is dependent upon the completion of the work covered by Section 23 05 92, "Testing/Adjusting/Balancing: Heating/Ventilating/Cooling Systems" must have that work completed as a prerequisite to testing work under this section. Indicate in each field test plan when such prerequisite work is required.

d. Test Procedure: Indicate in each field test plan each equipment manufacturers published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing all automatic controls provided by the manufacturer. Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures shall be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control. Controllers shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

e. Performance Variables: Each test plan shall list performance variables that are required to be measured or tested as part of the field test. Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Manufacturer shall furnish with each test procedure a description of acceptable results that have been verified. Manufacturer shall identify the acceptable limits or tolerances within which each tested performance variable shall acceptably operate.

f. Job Specific: Each test plan shall be job specific and shall address the particular item of equipment and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized Components: Each test plan shall include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

3.6.4.3 Equipment Requiring Field Test Reports:

a. Equipment Items for Reports: Equipment requiring field test reports are listed in paragraph "SD-12, Field Test Reports."

b. Manufacturer's Recommended Test: Conduct the manufacturer's recommend field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field testing.

c. Operational Test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.

d. Notice of Tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

e. Report Forms: Type all data entries and writing on the test report forms. Completed test report forms for each item of

equipment shall be reviewed, approved, and signed by the Contractor's test director and the QC Manager. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.

f. Deficiency Resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

3.6.5 Boiler

Hydrostatically test at pressure of not less than 60 psig before being placed in operation. Notify Contracting Officer in writing when boiler is ready for testing and before boiler is operated. Government boiler inspector shall be notified by the Contracting Officer and shall witness boiler tests and approve before boiler units are placed in operation or accepted.

3.6.6 Additional Field Testing

Provide testing, adjusting, and balancing (TAB) of ducts, piping, and equipment under Section 23 05 92, "Testing/Adjusting/Balancing: Heating/Ventilating/Cooling Systems."

3.6.7 Testing and Balancing

Balance airflow in accordance with SMACNA and flows indicated. Submit written certificate to report the following:

a. Air-handling unit and condensing unit nameplate data, and actual voltage and ampere consumption.

b. Supply and return terminal airflow, and equipment used to measure airflow.

c. Air-handling unit in and out cfm and temperatures, rpm of fan if belt driven.

d. Ambient outside air temperature, date, and person testing, balancing, and reporting.

3.6.8 Testing EMCS Equipment

a. All EMCS equipment shall be given an operation test.

b. Items not operating properly shall be repaired or replaced and retested.

TABLE 15701-1
EQUPMENT MINIMUM EFFICIENCY REQUIREMENTS
Equipment must meet each rating listed

Equipment Type	Efficiency	Rating Condition
Air to Air Unitary Air Conditioner (Packaged and Split)		
<65 Mbtu/hr	12.0 SEER	
65-135 Mbtu/hr	11.0 EER	
	11.4 IPLV	
136-240 Mbtu/hr	10.8 EER	
	11.2 IPLV	
Air to Air Unitary Heat Pump (Packaged and Split)		
<65 Mbtu/hr	12.0 SEER	
	7.7 HSPF	
65-135 Mbtu/hr	10.1 EER	
	10.4 IPLV	
	3.2 COP	
136-240 Mbut/hr	9.3 EER	
	9.5 IPLV	
	3.1 COP	
Air Cooled Water Chiller	1.23 Full Load kW/ton	ARI 550/590-98
	.90 IPLV kW/ton	ARI 550/590-98
Air Cooled Condensing Units	12.0 SEER	
	11.0 EER	
	11.4 IPLV	
Room Air Conditioner (Window, not thru the wall)		
<20,000 btu/hr	10.7 EER	DOE test procedure
=>20,000 btu/hr	9.42 EER	DOE test procedure
Package Terminal Air Conditioner	10=(.16xCap/1000)*EER	ARI 310/380 @ 95 F Outdoor
	12.2-(.2xCap/1000)*EER	ARI 310/380 @ 82 F Outdoor
Package Terminal Heat Pump	10-(.16xCap/1000)*EER	ARI 310/380 @ 95 F Outdoor
	12.2-(.2xCap/1000)*EER	ARI 310/380 @ 82 F Outdoor
	2.9-(.026xCap/1000)*COP	ARI 310/380 @ 47 F Outdoor

*Capacity is cooling capacity in but/hr. Use 7,000 if cap is less than 7,000, use 15,000 if cap is greater than 15.000.

TABLE 15701-1
EQUPMENT MINIMUM EFFICIENCY REQUIREMENTS
Equipment must meet each rating listed

Equipment Type	Efficiency	Rating Condition
Computer Room Air Conditioner	8.9 EER	
Water Source Heat Pump		
Open Loop	16.2 EER	@ 59 F EWT
	3.6 COP	@ 50 F EWT
Closed Loop	14.1 EER	@ 77 F EWT
	3.3 COP	@ 32 F EWT
Oil Fired Heating Boilers		
Water	83% Et	
Steam	83% Et	
Natural Gas Fired Heating Boiler		
Water	80% Et	
Steam		
<2,500,000	79% Et	
=>2,500,000	80% Et	
Direct Vent Gas-Fired Central Furnaces		
<225,000 input	90%	

-- End of Section --

SECTION 26 00 00

BASIC ELECTRICAL MATERIALS AND METHODS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709	(2000) Laminated Thermosetting Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 100	(1996) Dictionary of Electrical and Electronics Terms (IEEE)
IEEE C2	(1997) National Electrical Safety Code (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C57.12.28	(1999) Pad-Mounted Equipment - Enclosure Integrity (Revision of ANSI C57.12.28-88)
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1998; Errata 1999) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide for Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 31, "Earthwork," Division 11, "Equipment," Division 13, "Special Construction," and Division

14, "Conveying Systems" and Division 23, "Heating, Ventaling and Air Conditioning". This section applies to all sections of Division 26, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be _____ kV primary, single, three phase, two, three, four wire, 60, 50 Hz, and _____ volts secondary, single, three phase, three, four wire. Final connections to the power distribution system at the existing substation, manhole shall be made by the Contractor as directed by the Contracting Officer, Government.

1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01 33 00, "Submittal Procedures" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5.2 Drawings

Submit drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed

location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

1.5.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.5.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01 78 23, "Operation and Maintenance Data" and the technical sections.

1.5.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.6.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.6.7 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Provide red laminated plastic label with white center core where indicated. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with NEMA C57.12.28, such as for pad-mounted transformers and pad-mounted SF6 switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10

inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

1.10 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each cable or wire located in manholes, handholes, and vaults. Tag only new wire and cable provided by this contract. The first position on the tag shall denote the voltage. The second through sixth _____ positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. Tag legend shall be as indicated. The tags shall be polyethylene. Do not provide handwritten letters. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

1.10.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.11.1 Motors and Equipment

Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, including control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 26.

Provide motors, controllers, integral disconnects, and contactors with their respective pieces of equipment, except controllers indicated as part of the motor control centers shall be provided under Section 26 20 00, "Interior Distribution System". Motors, controllers, integral disconnects, and contactors shall conform to Section 26 20 00, "Interior Distribution System" except motors, controllers, contactors, and disconnects for fire pumps shall be provided under Section 21 30 00, "Fire Pumps". Extended voltage range motors shall not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. When motors and equipment furnished are larger than sizes indicated, the cost of

additional electrical service and related work shall be included under the section that specified that motor or equipment. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated. As an exception to these requirements, provide disconnect switches, contactors, and controllers for existing motor-operated equipment under Section 26 20 00, "Interior Distribution System."

1.11.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment under Section 26 20 00, "Interior Distribution System." Power wiring and conduit shall conform to Section 26 20 00, "Interior Distribution System." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.11.3 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 16, except internal wiring for components of packaged equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.11.4 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 16.

1.11.5 High Efficiency Motors

1.11.5.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.11.5.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-10 of NEMA MG 1.

1.11.6 Three-Phase Motor Protection

Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

1.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

1.14 EQUIPMENT INVENTORY UPDATE

Submit information for each piece of equipment removed and supplied for use of Camp Lejeune to update the Maximo equipment inventory. For the purposes of this paragraph, inventoried equipment is defined as equipment listed on the Maximo Equipment Inventory Update form.

1.14.1 Requirements

The contractor shall prepare and submit one Maximo Equipment Inventory Update form for each individual item of inventoried equipment that is demolished, removed, replaced, or installed. (ex: three new condensing units would require the submission of three Equipment Inventory Update forms. The replacement of two existing air handling units with two new air handling units would require the submission of two Equipment Inventory Update forms). The contractor shall prepare and submit a VAV/TAB Room Number List for each VAV/Tab model installed in a single building. Only one Maximo Equipment Inventory Update form is required for each model of VAV or TAB in a single building.

1.14.1.1 Demolition of all equipment in a structure or facility

When all the inventoried equipment in a building or structure is demolished or removed, and not replaced, an Equipment Inventory Update form is not

required.

1.14.1.2 Standards

The contractor shall provide accurate, complete, and legible information on all required forms. All required forms shall be completed and delivered to the Contracting Officer on or before the Beneficial Occupancy Date. All information on Equipment Inventory Update forms shall be obtained by visual inspection of equipment data plate(s).

1.14.1.3 Form Preparation

Each required Maximo Equipment Inventory Update form shall contain the following information:

(1) The name and telephone number of an individual who can be contacted for clarification or additional information pertaining to the data on the form.

(2) The date of data collection

(3) The building or structure identification number and the specific location of the equipment within the structure (ex: 3d deck mech room)

(4) A check adjacent to the description of the new or replacement item, and a check adjacent to the supplemental description if applicable (ex: circulating pump and HVAC or steam)

(5) The Maximo number or serial number of the demolished or removed item, if applicable

(6) All applicable data from the equipment data plate

Each Room Number List form shall contain the following information:

(1) The name and telephone number of the individual providing the information

(2) The date the form was completed

(3) The building or structure identification number

(4) A check in the box adjacent to each applicable room number

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical sections.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00, "Paints and Coatings" the section specifying the associated electrical equipment.

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.4 CABLE TAG INSTALLATION

Install cable tags in each manhole, handhole, and vault as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

MAXIMO EQUIPMENT INVENTORY UPDATE

Employee: _____ Phone: _____ Date: ____/____/____

Bldg: _____ Specific Location: _____

__ AC, Computer Room
__ AC, Package
__ AC, Package Terminal
__ Assembly, Trap line
__ Backflow Preventer
__ Boiler
__ Chiller, Air Cooled Recip
__ Chiller, Air Cooled Screw
__ Chiller, Air Cooled Scroll
__ Chiller, Water Cooled Recip
__ Chiller, Water Cooled Screw
__ Compressor, Control Air
__ Compressor, Industrial Air
__ Dryer, Refrigerated Air
__ Exchanger, Heat
__ Evaporator, Freezer
__ Evaporator, Refrigerator
__ Fan, Exhaust
__ Generator
__ Heater, Space
__ Heater, Unit
__ Heat Pump, Geo-Thermal
__ Heat Pump, Indoor Unit
__ Heat Pump, Outdoor Unit
__ Heat Pump, Package
__ Heat Pump, Package Terminal
__ Pump, Circulating, Chilled Water
__ Pump, Circulating, Domestic Water
__ Pump, Circulating, Dual Temp Water
__ Pump, Circulating, Heating Water
__ Pump, Condensate
__ Pump, Sump
__ Regulator, Temperature
__ Tank, Hot Water Storage
__ Tower, Cooling
__ Unit, Air Handling
__ Unit, AC Condensing
__ Unit, Freezer Condensing
__ Unit, Refrigerator Condensing
__ Unit, Fan Coil
__ Unit, TAB (Attach Room No. List)
__ Unit, VAV (Attach Room No. List)
__ Valve, Pressure Reducing
__ Valve, Steam Pilot
__ Water Heater

Demolished/Removed Equipment

Maximo no: _____ or Ser no: _____

New Equipment

Manufacturer: _____

Model no: _____

Ser no: _____

Type: __Elec __Oil __LP Gas __Nat Gas __Steam __Water __Air

Motor Data: HP____ Volts____ Phase____ RLA_____ RPM____ Frame____

Tons____ No. of Motors____ no. of Belts____ Belt size(s)____ CFM____

KW____ Refrig type_____ Refrig Qty_____ Filter Size(s)_____

VAV/TAB Room Number List

Emplyee: _____ Phone: _____

Bldg: _____ Date: _____

VAV/TAB Model Number: _____

- ☐ 100
- ☐ 101
- ☐ 102
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- ☐ 374
- ☐ 375

Instructions

(1) Confirm room numbers by visual inspection
(2) Check the box next to each applicable room number

-- End of Section --

SECTION 26 06 00

GROUNDING AND BONDING

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C25	(1995) Sawn Crossarms, Pressure Treatment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 80	(1987) IEEE Guide for Safety in AC Substation Grounding
IEEE 837	(1989) Permanent Connections Used in Substation Grounding

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 780	(1997) Lightning Protection Code

UNDERWRITERS LABORATORIES (UL)

UL 83	(1998; Rev thru Oct 1999) Thermoplastic-Insulated Wires and Cables
UL 96	(1994; Rev thru Jan 2000) Lightning Protection Components
UL 467	(1993; Rev thru Apr 1999) Grounding and

Bonding Equipment

1.2 SUBMITTALS

Submit the following in accordance with section 01 33 00, "Submittals Procedures."

SD-02 Shop Drawings

Layout and location drawings

SD-03 Product Data

Ground rods

Grounding Plates

Bonding and grounding grids

Grounding and bonding connectors

Grounding and bonding conductors

SD-06 Test Reports

Submit report of results of acceptance checks and tests specified by paragraph entitled "Field Quality Control"

Ground resistance tests

1.2.1 Layout and location drawings

Provide shop drawings showing location and size of ground rod and ground grid.

1.2.2 Ground resistance tests

Upon completion and before final acceptance of the work, submit the measured ground resistance of each ground rod and grounding system, including the location of the rod and grounding system and soil conditions at the time the measurements were taken.

PART 2 PRODUCTS

2.1 GROUND RODS

Provide ground rods made of copper-clad steel conforming to UL 467. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length.

2.2 GROUNDING PLATES

Provide grounding plates made of copper-clad steel conforming to UL 96.

2.3 BONDING AND GROUNDING GRIDS

2.4 GROUNDING AND BONDING CONNECTORS

IEEE 837, UL 467, UL 96, pressure-type connector (compression, clamp) and

exothermic weld. Provide type and size of connectors required for the installation.

2.5 GROUNDING AND BONDING CONDUCTORS

Solid bare copper wire meeting the requirements of ASTM B 1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B 8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

2.5.1 Flexible Jumper Cable

Welding cable, 2/0 AWG. Provide flexible cable in areas where movement or vibration requires a grounding connections.

2.6 GROUND WIRE AND WIRE PROTECTOR

Provide soft drawn copper wire ground conductors a minimum No. 4 AWG. Ground wire protectors may be either PVC or half round wood molding. Wood molding shall be fir, pressure treated in accordance with AWPA C25, or shall be cypress or cedar.

PART 3 EXECUTION

3.1 INSTALLATION

Grounding installation shall conform to the requirements of NFPA 70, NFPA 780, and ANSI C2.

3.1.1 Ground Rod Connections

Connect ground conductor to the upper end of ground rod by exothermic weld or by compression connector. Make exothermic welds strictly in accordance with manufacturer's written recommendations. Welds which have puffed up of which show convex surfaces indicating improper cleaning, are not acceptable. No mechanical connectors are required at exothermic weldments. Compression connectors shall be type that uses a hydraulic compression tool to provide correct pressure. Provide tools and dies recommended by compression connector manufacturer. An embossing die or similar method shall provide visible indication that a connector has been fully compressed on ground wire. Top of ground rod shall be not less than 6 inches below the frostline.

3.1.2 Grounding and Bonding

NFPA 70. Ground noncurrent carrying metal parts of equipment or enclosure, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flange pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.3 Overhead Pole Line Grounding

Protect grounding conductors which are run on surface of wood poles by wood molding or plastic molding of equal mechanical strength extending from ground line throughout communication and transformer spaces. Protect protective molding by preformed sheet steel guard, No. 14 gage minimum, extending from 6-inches below and to at least 4.5 feet above ground line.

3.1.4 Surge Arresters

Connect grounding terminal of each arrester to ground.

3.1.5 Pad-Mounted Transformer and Interrupter Switches Grounding

Provide a 1/0 bare copper-ground girdle around transformer and interrupter switches. Girdle shall be buried one foot deep and placed 3 feet laterally from the equipment enclosure. Connect girdle to enclosure at two opposite places using 1/0 copper conductor. Exothermically weld joints.

3.1.6 Substation Grounding

IEEE Std 80, provide NO. 4/0 AWG bare copper ground connection to substation ground grid and rods. Transformer neutral connections shall not be smaller than No. 2/0 AWG. Fence and equipment connections shall not be smaller than No. 4 AWG. Ground fence at each gate post and cornerpost and at intervals not exceeding 10 feet. Bond each gate section to the fence post through a 1/8 by one inch flexible braided copper strap and clamps or jumper cable. Clamps shall be of the anti-electolysis type.

3.1.7 Ground Cable Crossing Expansion Joints in Structures and Pavements

Protect from damage by means of approved devices or methods of installation to allow the necessary slack in the cable across the joint to permit movement.

3.1.8 Bonding and Grounding Grids

Install in accordance with IEEE Std 80 with minimum buried depth of 20 inches. All cross connections shall be silver brazed using a 35 percent silver brazed alloy and a non-corrosive flux. Interconnect by welding all cross connections of adjacent sections of grid and to ground rods.

3.1.9 Ground Resistance

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

a. Generating and control equipment 1000 volts and over: 1 ohm

b. Pad-mounted transformers: 5 ohms

c. Ground in manholes, handholes, and vaults: 5 ohms

d. Grounding other metal enclosures of primary voltage electrical and electically-operated equipment: 5 ohms

e. Grounded secondary distribution system neutral and noncurrent-carrying metal parts associated with distribution

systems and grounds not otherwise covered: 5 ohms

When work in addition to that indicated or specified is directed in order to obtain the specified ground resistance, the provisions of the contract covering "changes" shall apply.

Shall be as indicated, and as required by NFPA 70 and ANSI C2.

3.2 FIELD QUALITY CONTROL

3.2.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NETA ATS, and referenced standards specified herein. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.2.2 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plan and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the three-point method.

-- End of Section --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2003) Acceptance Testing Specifications

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections

SD-07 Certificates

Qualifications of organization, and lead engineering technician

Acceptance test and inspections procedure

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

a. Section 26 32 13.00 20 SINGLE-OPERATION GENERATOR SETS. Functional engine shutdown tests, vibration base-line test, and load bank test shall not be performed by the testing organization. These tests shall be performed by the start-up engineer.

b. Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS

c. Section 26 12 19.20 SINGLE-PHASE PAD-MOUNTED TRANSFORMERS

d. Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION

e. Section 33 71 02.00 20 UNDERGROUND TRANSMISSION AND DISTRIBUTION

f. Section 26 13 00.00 20 PAD-MOUNTED SF6 INSULATED INTERRUPTER SWITCHES

g. Section 26 11 16 SECONDARY UNIT SUBSTATIONS

h. Section 26 11 13.00 20 PRIMARY UNIT SUBSTATIONS

i. Section 26 36 23.00 20 AUTOMATIC TRANSFER SWITCHES

j. Section 26 23 00 SWITCHBOARDS AND SWITCHGEAR

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 26 12 19.10

THREE-PHASE PAD-MOUNTED TRANSFORMERS

04/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318M/318RM	(1999) Metric Building Code Requirements for Structural Concrete and Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D 92	(2002; Rev. A) Flash and Fire Points by Cleveland Open Cup IP Designation: 36/84 (89); AASHTO No.: T 48; DIN 51 376
ASTM D 97	(2002) Pour Point of Petroleum Products IP Designation: 15/95
ASTM D 877	(2002) Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 1535	(1997) Specifying Color by the Munsell System

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 712-C-98-075	(1998) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"
EPA 600/4-90/027F	(1993) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(2003) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 386	(1995; R 2001) Separable Insulated Connection

IEEE C2	(2002) National Electrical Safety Code (IEEE)
IEEE C12.7	(1993) Watthour Meter Sockets (IEEE)
IEEE C57.12.00	(2000) Liquid-Immersed Distribution, Power, and Regulating Transformers (IEEE)
IEEE C57.12.80	(2002) Terminology for Power and Distribution Transformers (IEEE)
IEEE C57.12.90	(1999) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers (IEEE)
IEEE C57.13	(1993) Instrument Transformers (IEEE)
IEEE C57.98	(1993; Correction 1998) Guide for Transformer Impulse Tests (IEEE)
IEEE C62.11	(1999) Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV) (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C12.1	(2001) Electric Meters; Code for Electricity Metering
NEMA C12.10	(1997) Watthour Meters
NEMA C37.47	(2000) High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
NEMA C57.12.22	(1993; R 1998) Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings, 2500 kVA and Smaller: High Voltage, 34 500 GrdY /19 920 Volts and Below; Low Voltage, 480 Volts and Below
NEMA C57.12.26	(1993) Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVA and Smaller
NEMA C57.12.28	(1999) Pad-Mounted Equipment - Enclosure Integrity
NEMA C57.12.29	(1999; Errata 2000) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1993) Fish Acute Toxicity Test

UNDERWRITERS LABORATORIES (UL)

UL 467	(1993; R 2001) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," and Section 26 07 00, "Apparatus Inspection and Testing," apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; by GE in Shreveport, LA; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be submitted:

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings", item a).

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings", item b).

d. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses (paragraph entitled "Pad-Mounted Transformer Drawings", item e).

e. Routine and other tests (in PART 2, see paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may, will be witnessed by the government (in Part 2, see paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.

f. Provide acceptance test reports required by submittal item "SD-06 Test Reports".

g. Provide operation and maintenance manuals required by submittal item

"SD-10 Operation and Maintenance Data".

SD-02 Shop Drawings

Pad-mounted transformer drawings

SD-03 Product Data

Pad-mounted transformers

SD-06 Test Reports

Acceptance checks and tests

SD-07 Certificates

Transformer losses

SD-09 Manufacturer's Field Reports

Pad-mounted transformer design tests

Pad-mounted transformer routine and other tests

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5

SD-11 Closeout Submittals

Transformer test schedule

1.4 QUALITY ASSURANCE

1.4.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, with front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams with terminals identified of watthour meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuses.

1.4.2 Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

1.4.3 Transformer Product Data

Submittal shall include manufacturer's information for each component,

device, and accessory provided with the transformer.

1.4.4 Test Results

Submit report of test results as specified by paragraph entitled "Field Quality Control"

1.5 MAINTENANCE

1.5.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Information on watthour demand meter, CT's, and fuse block

g. Actual nameplate diagram

h. Date of purchase

1.5.2 Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23, "Operation and Maintenance Data" and as specified herein.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 01.00 20, "Overhead Transmission and Distribution", Section 33 71 02.00 20, "Underground Transmission and Distribution", and Section 26 20 00, "Interior Distribution System".

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

NEMA C57.12.26, NEMA C57.12.22, NEMA C57.12.28, NEMA C57.12.29 and as specified herein.

2.2.1 Compartments

The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE Std 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts and feed-thru inserts: IEEE Std 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise. Provide feed-thru inserts as indicated.

c. Load-break switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handles in the high-voltage compartment. Operation of switches shall be as follows:

ARRANGEMENT NO.	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION LINE A SW. OPEN	LINE A SW. CLOSE	LINE B SW OPEN	LINE B SW CLOSE	XFMR. SW OPEN	XFMR. SW CLOSE
1	Line A connected to Line B and both lines connected to transformer		X		X		X
2	Transformer connected to Line A only		X	X			X
3	Transformer connected to Line B only	X			X		X
4	Transformer open and loop closed		X		X	X	
5	Transformer	X		X		X	

ARRANGEMENT NO.	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION LINE A SW. OPEN	LINE A SW. CLOSE	LINE B SW OPEN	LINE B SW CLOSE	XFMR. SW OPEN	XFMR. SW CLOSE
	open and loop open						

d. Provide bayonet type, oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: NEMA C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

e. Surge arresters: IEEE C62.11, rated 9, 10 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap, suitable for plugging into inserts. Provide three arresters for radial feed circuits. Provide three arresters for loop feed circuits.

f. Parking stands: Provide a parking stand near each bushing well. Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

g. Protective caps: IEEE Std 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts and insulated standoff bushings.

2.2.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

b. Metering: NEMA C12.10. Provide a socket-mounted electronic programmable outdoor watthour meter, surface mounted flush against the side of the low-voltage compartment as indicated. Meter shall either be programmed at the factory or shall be programmed in the field. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements.

1. Design: Provide meter designed for use on a 3-phase, 4-wire, as 208Y/120, 480Y/277 volt system with 3 current transformers, as indicated in scope of work. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).

2. Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.

3. Class: 20; Form: 9S; Accuracy: +/- 1.0 percent; Finish: Class II

4. Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

5. Kilowatt-hour Register: 5 digit electronic programmable type

6. Demand Register:

   (a) Provide solid state

   (b) Meter reading multiplier:

      (1) Indicate multiplier on the meter face.

   (c) Demand interval length: shall be programmed for 15, 30, 60 minutes with rolling demand up to six subintervals per interval.

7. Meter fusing: Provide a fuse block mounted in the secondary compartment containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.

8. Socket: IEEE C12.7. Provide NEMA Type 3R, box-mounted socket having automatic circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Paint box Munsell 7GY3.29/1.5 green to match the pad-mounted transformer to which the box-mounted socket is attached. The Munsell color notation is specified in ASTM D 1535.

9. Current transformers: IEEE C57.13. Provide butyl-molded window type current transformers with 600-volt insulation, 10 kV BIL and mount on the low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters. Provide three current transformers per power transformer with characteristics listed in the following table.

kVA	Sec. Volt	CT Ratio	RF	Meter Acc. Class
500	208Y/120	1200/5	1.5	0.3 thru B-0.5
750	480Y/277	800/5	2.0	0.3 thru B-0.5

2.2.2 Transformer

a. Less-flammable liquid-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated as indicated kVA, 95 kV BIL.

c. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

d. Minimum tested impedance shall not be less than _____ percent at 85 degrees C.

e. Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58
1500	60

g. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.2.1 Specified Transformer Losses

No-load losses (NLL) shall be as indicated watts at 20 degrees C and load losses (LL) shall be as indicated watts at 85 degrees C. The values for the specified losses shall be used for comparison with the losses determined during the routine tests. If the routine test values for no-load losses exceed the specified no-load losses by more than 10 percent, or the total losses exceed the specified total losses (sum of no-load and load losses) by more than 6 percent, the transformer is unacceptable.

2.2.3 Insulating Liquid

a. Less-flammable transformer liquids: NFPA 70 and FM P7825 for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D 92 and a dielectric strength not less than 33 kV tested per ASTM D 877. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

The fluid shall be a biodegradable electrical insulating and cooling liquid classified by UL and approved by FM as "less flammable" fluids. The fluid shall meet the following fluid properties:

1. Pour point: ASTM D 97, less than -15 degree C

2. Aquatic biodegradation: EPA 712-C-98-075, 100%

3. Trout toxicity: OECD Test 203, zero mortality of EPA 600/4-90/027F,

pass

2.2.3.1 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.4 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with NEMA C57.12.28 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D 1535.

2.3 WARNING SIGNS

Provide as specified in Section 26 00 00, "Basic Electrical Materials and Methods."

2.4 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02, "Underground Transmission and Distribution."

2.5 CAST-IN-PLACE CONCRETE

Concrete associated with electrical work for other than encasement of underground ducts shall be 3000 psi minimum 28-day compressive strength unless specified otherwise. All concrete shall conform to the requirements of Section 03 30 00.00 20, "Cast-in-Place Concrete."

2.6 SOURCE QUALITY CONTROL

2.6.1 Transformer Test Schedule

The Government reserves the right to, will witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

1. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

4. Dated calibration labels shall be visible on all test equipment.

5. Calibrating standard shall be of higher accuracy than that of the instrument tested.

6. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

   (a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

   (b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.6.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s). Design tests shall have been performed prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (ONAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.

   1. IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

   2. State test voltage levels.

   3. Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with NEMA C57.12.26, NEMA C57.12.22.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.6.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Phase relation

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

(a) State test voltage levels

(b) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test reports. As an alternative, photographs of oscilloscope display waveforms or plots of digitized waveforms may be hand-delivered at the factory witness test.

(c) The Officer in Charge (OIC) will select the transformers to be tested.

2. Applied voltage

3. Induced voltage

g. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02, "Underground Transmission and Distribution". Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 33 71 02, "Underground Transmission and Distribution."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 TRANSFORMER GROUNDING

Provide a 1/0 bare copper-ground girdle around transformer. Girdle shall be buried one foot deep and placed 3 feet laterally from the transformer enclosure. Connect girdle to enclosure at two opposite places using 1/0 copper. Exothermically weld joints.

3.4 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4.1 Meters and Current Transformers

NEMA C12.1.

3.5 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.5.1 Cast-In-Place Concrete

Cast-in-place concrete work shall conform to the requirements of Section 03 30 00.00 20, "Cast-in-Place Concrete" ACI 318M/318RM.

3.5.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect

all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.6 FIELD QUALITY CONTROL

3.6.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.6.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate information with specifications and approved shop drawings.

2. Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

3. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

4. Verify correct liquid level in tanks.

5. Perform specific inspections and mechanical tests as recommended by manufacturer.

6. Verify correct equipment grounding.

7. Verify the presence of transformer surge arresters.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance tests.

3. Perform turns-ratio tests.

4. Perform insulation power-factor/dissipation-factor tests on windings.

5. Sample insulating liquid. Sample shall be tested for:

(a) Dielectric breakdown voltage

(b) Acid neutralization number

(c) Specific gravity

(d) Interfacial tension

(e) Color

(f) Visual condition

(g) Water in insulating liquid

(h) Measure dissipation factor or power factor

6. Perform dissolved gas analysis (DGA).

7. Test for presence of PCB.

8. Verify that the tap-changer is set at specified ratio.

9. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.6.1.2 Current Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Verify that adequate clearances exist between primary and secondary circuit.

5. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

6. Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance test.

3. Perform a polarity test.

4. Perform a ratio-verification test.

3.6.1.3 Watthour Meter

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of electrical connections.

b. Electrical tests

1. Calibrate watthour meters according to manufacturer's published data.

2. Verify that correct multiplier has been placed on face of meter, where applicable.

3. Verify that current transformer secondary circuits are intact.

3.6.1.4 Grounding System

a. Visual and mechanical inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

2. Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.6.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 26 12 19.20

SINGLE-PHASE PAD-MOUNTED TRANSFORMERS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C57.12.25	(1990) Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with Separable Insulated High-Voltage Connectors; High Voltage, 34 500 GrdY/19 920 Volts and Below; Low-Voltage, 240/120 Volts; 167 kVA and Smaller

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM D 92	(1998; Rev. A) Flash and Fire Points by Cleveland Open Cup IP Designation: 36/84 (89); AASHTO No.: T 48; DIN51 376
ASTM D 117	(1996) Electrical Insulating Oils of Petroleum Origin
ASTM D 877	(1987; R 1995) Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 1535	(1997) Specifying Color by the Munsell System
ASTM D 3455	(1995) Compatibility of Construction Material with Electrical Insulating Oil of Petroleum Origin
ASTM D 3487	(1988; R 1993) Mineral Insulating Oil Used in Electrical Apparatus

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(1999) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V (IEEE)
IEEE C2	(1997) National Electrical Safety Code (IEEE)
IEEE C12.4	(1984; R 1990) Mechanical Demand Registers (IEEE)
IEEE C12.7	(1993) Watthour Meter Sockets (IEEE)
IEEE C12.15	(1990) Electricity Metering Solid-State Demand Registers for Electromechanical Watthour Meters
IEEE C12.16	(1991) Electricity Metering Solid-State Electricity Meters
IEEE C57.12.00	(2000) Liquid-Immersed Distribution, Power, and Regulating Transformers (IEEE)
IEEE C57.12.80	(1978; R 1992) Terminology for Power and Distribution Transformers (IEEE)
IEEE C57.12.90	(1999) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers (IEEE)
IEEE C57.13	(1993) Instrument Transformers (IEEE)
IEEE C57.98	(1993; Correction 1998) Guide for Transformer Impulse Tests (IEEE)
IEEE C62.11	(1999) Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV) (IEEE)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C12.1	(1995) Code for Electricity Metering
NEMA C37.47	(1981; R 1992) Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses
NEMA C57.12.28	(1999) Pad-Mounted Equipment - Enclosure Integrity (Revision of ANSI C57.12.28-88)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467 (1993; R 1999, Bul. 2000) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," and Section 26 08 00, "Apparatus Inspection and Testing," apply to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

As an exception to this paragraph, transformers manufactured by ABB in Jefferson City, MO; by Cooper Power Systems in Waukesha, WI; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be submitted:

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. An outline drawing of the transformer with devices identified (paragraph entitled "Pad-Mounted Transformer Drawings," item a).

c. ANSI nameplate data of the transformer (paragraph entitled "Pad-Mounted Transformer Drawings," item b).

d. Routine and other tests (paragraph entitled "Routine and Other Tests"), shall be conducted by the manufacturer and may, will be witnessed by the Government (paragraph entitled "Source Quality Control"). Provide transformer test schedule required by submittal item "SD-11 Closeout Submittals". Provide certified copies of the tests.

e. Provide acceptance test reports required by submittal item "SD-06 Test Reports".

f. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

SD-02 Shop Drawings

Pad-mounted transformer drawings

SD-03 Product Data

Single-phase pad-mounted transformers (dead-front)

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance checks and tests

Submit report of results of acceptance checks and tests specified by paragraph entitled "Field Quality Control."

SD-07 Certificates

Transformer losses

SD-09 Manufacturer's Field Reports

Pad-mounted transformer design tests

Pad-mounted transformer routine and other tests

Silicone compatibility tests

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23, "Operation and Maintenance Data" and as specified herein.

SD-11 Closeout Submittals

Transformer test schedule

1.4 QUALITY ASSURANCE

1.4.1 Pad-Mounted Transformer Drawings

Drawings shall indicate, but not be limited to the following:

a. An outline drawing, including front, top, and side views.

b. ANSI nameplate data.

c. Elementary diagrams and wiring diagrams with terminals identified of meter and current transformers.

d. One-line diagram, including switch(es), current transformers, meters, and fuses.

e. Manufacturer's published time-current curves (on full size logarithmic paper) of the transformer high side fuse.

1.4.2 Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

1.5 MAINTENANCE

1.5.1 Additions to Operation and Maintenance Data

In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted

b. An outline drawing, including front, top, and side views

c. Supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

f. Information on meter, CT's, and fuse block

g. Actual nameplate diagram

h. Date of purchase

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 33 71 01, "Overhead Transmission and Distribution," Section 33 71 02, "Underground Transmission and Distribution," and Section 26 20 00, "Interior Distribution Systems".

2.2 SINGLE-PHASE PAD-MOUNTED TRANSFORMERS (DEAD-FRONT)

ANSI C57.12.25, NEMA C57.12.28, and as specified herein.

2.2.1 Compartment Construction

a. Single compartment: Shall be Type 1 as defined by ANSI C57.12.25 with combination high- and low-voltage compartment. Compartment shall be of the clam shell type with lockable (having pad-locking provisions) hinged cover and single-point latching.

b. Two compartment: The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage

High-voltage portion shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, feed-through inserts, two, four high-voltage bushing wells configured for loop feed application, access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE Std 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connectors and inserts shall be the product of a single manufacturer. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts and feed-through inserts: IEEE Std 386, 200 amperes, 15 kV class. Provide a bushing well insert for each bushing well unless indicated otherwise. Provide feed-through inserts as indicated.

c. Provide bayonet oil-immersed, expulsion fuses in series with

oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning shall be conspicuously displayed adjacent to the bayonet fuse(s) cautioning against removing or inserting fuses unless the transformer has been de-energized and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: NEMA C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

d. Surge arresters: IEEE C62.11, rated 10 kV, fully shielded, dead-front metal-oxide-varister, elbow type with resistance-graded gap suitable for plugging into inserts as indicated.

e. Parking stands: Provide a parking stand near each bushing well. Provide insulated standoff bushings for parking of energized load-break connectors on parking stands.

f. Protective caps: IEEE Std 386, 200 amperes, 15 kV class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushing well inserts and insulated standoff bushings.

2.2.1.2 Low Voltage

Low-voltage portion shall contain low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized aluminum diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain plug, fill plug, pressure relief device and a liquid level sight gage.

b. Metering

(1) Metering for single compartment transformers: Provide an electronic kilowatt demand meter mounted in the low-voltage portion of the pad-mounted transformer as indicated.

(a) Meter: Provide kilowatt demand meter coordinated to ratios of current transformers and transformer secondary voltage. Meter shall indicate the highest demand load over a 15-minute interval conforming to IEEE C12.4. Meter accuracy shall be within plus or minus one percent. Provide correct multiplier on face of meter.

(b) Meter fusing: Provide a fuse block mounted in the secondary side containing one fuse per phase to protect the voltage input to the meter. Size fuses as recommended by the meter manufacturer.

(c) Metering assembly: Provide complete system including all

devices required.

(2) Metering for two-compartment transformers: Provide a socket-mounted electronic programmable outdoor watthour meter, surface mounted flush against the side of the low-voltage compartment as indicated. Meter shall either be programmed at the factory or shall be programmed in the field. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements and conform to IEEE C12.16.

(a) Design: Provide meter designed for use on a single-phase, three-wire, 240/120, 480/240 volt system with two current transformers as indicated on the drawings. Include necessary KYZ pulse initiation hardware for energy monitoring and control system (EMCS) as specified in Section 23 09 54, "Direct Digital Control Systems".

(b) Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.

(c) Class: 20
Form: 4S, accuracy: plus or minus 1.0 percent
Finish: Class II

(d) Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

(e) Kilowatt-hour register: five digit electronic programmable type

(f) Demand register

1. Provide solid state IEEE C12.15

2. Meter reading multiplier: Indicate multiplier on the meter face.

3. Demand interval length: shall be programmed for 15, 30, 60 minutes with rolling demand up to six subintervals per interval.

(g) Meter fusing: Provide a fuse block mounted in the secondary side containing one fuse per phase to protect the voltage input to the meter. Size fuses as recommended by the meter manufacturer.

(h) Socket: IEEE C12.7. Provide NEMA Type 3R, box-mounted socket having automatic circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Paint box Munsell 7GY3.29/1.5 green to match the pad-mounted transformer to which the box-mounted socket is attached. The Munsell color notation is specified in ASTM D 1535.

(3) Current transformers IEEE C57.13. Provide butyl-molded window type current transformers with 600-volt insulation, 10 kV BIL and mount on the low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters. Provide two current

transformers per power transformer with characteristics listed in the following table.

NAME	KVA	SEC. VOLT	CT RATIO	RF	METER ACC. CLASS
T1	50	240	200/5	4.0	0.3 thru B-0.1
T2	75	480	200/5	4.0	0.3 thru B-0.1

2.2.2 Transformer Type and Ratings

a. Medium tested impedance shall not be less than manufacturer's standare design impedance.

b. Oil-insulated, Less flammable liquid-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

c. Transformer voltage ratings: 12.470, 7200 V - 240/120, 480/240 V.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage.

e. Transformer(s) shall have characteristics per the following table:

NAME	LOCATION	KVA	BIL (KV)	MIN TESTED IMP DB (MAX)
T1	AMTC Site 1	50	60	48
T2	AMTC Site 2	75	60	51

f. Transformer shall include lifting lugs and provisions for jacking under base recessed stainless steel lifting provisions. The transformer base construction shall be suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

2.2.3 Specified Transformer Losses

No-load losses (NLL) in watts at 20 degrees C, and load losses (LL) in watts at 85 degrees C, shall be as follows:

NAME	KVA	"NLL"	"LL"
T1	As Indicated	As Indicated	As Indicated
T2	As Indicated	As Indicated	As Indicated

The values for the specified losses shall be used for comparison with the losses determined during the routine tests. If the routine test values for no-load losses exceed the specified no-load losses by more than 10 percent, or the total losses exceed the specified total losses (sum of no-load and load losses) by more than 6 percent, the transformer is unacceptable.

2.3 INSULATING LIQUID

a. Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as non-PCB and Type II mineral oil on the nameplate.

b. Less flammable transformer liquids: NFPA 70 and FM P7825 for less flammable liquids having a fire point not less than 300 degrees C tested in accordance with ASTM D 92 and a dielectric strength not less than 33 kV tested in accordance with ASTM D 877. Do not provide nonflammable transformer liquids including askarel and insulating liquids containing polychlorinated biphenyls (PCB's) and tetrachloroethylene (perchloroethylene), chlorine compounds, and halogenated compounds. Provide identification of transformer as non-PCB and manufacturer's name and type of fluid on the nameplate.

(1) Silicone compatibility tests: When silicone is used as a less flammable transformer liquid, compatibility of silicone with seals and gasketing materials in oil-immersed tap changers and fuse holders shall be determined by compatibility tests conducted in accordance with ASTM D 3455. Test results shall show no evidence of shrinkage, swelling, or absorption caused by the liquid.

2.4 CORROSION PROTECTION

Front sill, hood, and tank base of single compartment transformers shall be corrosion resistant and shall be stainless steel, no less than No. 13 U.S. gage, conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 1.5 inches of concrete pad. Base and cabinets of two compartment transformers shall be corrosion resistant and shall be stainless steel, conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Paint bases, cabinets, and tanks Munsell 7GY3.29/1.5 green. Paint coating system shall comply with NEMA C57.12.28 regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D 1535.

2.5 WARNING SIGNS

Provide as specified in Section 26 00 00, "Basic Electrical Materials and Methods."

2.6 SOURCE QUALITY CONTROL

2.6.1 Transformer Test Schedule

The Government reserves the right to, will witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within

rated accuracy.

(2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.

(3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.6.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for each of the specified transformer(s). Design tests shall have been performed prior to the award of this contract.

a. Tests shall be certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (OA), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests shall include both the primary and secondary windings of that transformer.

(1) IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with ANSI C57.12.25.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

2.6.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests shall be as follows:

a. Cold resistance measurements (provide reference temperature)

b. Polarity

c. Ratio

d. No-load losses (NLL) and excitation current

e. Load losses (LL) and impedance voltage

f. Dielectric

(1) Impulse

(2) Applied voltage

(3) Induced voltage

g. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02, "Underground Transmission and Distribution". Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 23 71 02, "Underground Transmission and Distribution".

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 TRANSFORMER GROUNDING

Provide a 4/0 bare copper-ground girdle around transformer. Girdle shall be buried two foot deep and placed 3 feet laterally from the transformer enclosure. Connect girdle to enclosure at two opposite places using 1/0 copper. Exothermically weld joints.

3.4 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4.1 Meters and Current Transformers

NEMA C12.1.

3.5 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab. Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. The top of the concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have 1/2 inch chamfer. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant calking or sealant. Cut off and bush conduits 3 inches above slab surface. Concrete work shall be as specified in Section 03 30 00, "Cast-In-Place Concrete."

3.6 FIELD QUALITY CONTROL

3.6.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.6.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(4) Verify correct liquid level in tanks.

(5) Perform specific inspections and mechanical tests as recommended by manufacturer.

(6) Verify correct equipment grounding.

(7) Verify the presence of transformer surge arresters.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance tests.

(3) Perform turns-ratio tests.

(4) Perform continuity tests.

(5) Verify that the tap-changer is set at specified ratio.

(6) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3.6.1.2 Current Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary circuits and secondary circuit.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance test.

(3) Perform a polarity test.

(4) Perform a ratio-verification test.

3.6.1.3 Kilowatt Demand Meter, Watthour Meter

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical tests

(1) Calibrate watthour meters according to manufacturer's published data.

(2) Verify that correct multiplier has been placed on face of meter, where applicable.

(3) Verify that current transformer secondary circuits are intact.

3.6.1.4 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin

location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.6.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION 26 18 23.00 40

MEDIUM-VOLTAGE SURGE ARRESTERS

07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.11	(2005) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LA 1	(1992; R 1999) Standard for Surge Arresters

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Equipment and Performance Data shall be submitted for surge arresters including life, test, system functional flows, safety features, and mechanical automated details.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Provide the following shop drawings according to requirements set forth in this section:

Fabrication Drawings
Installation Drawings

SD-03 Product Data

Equipment and Performance Data shall be submitted for surge arresters in accordance with paragraph entitled, "General Requirements," of this section.

Manufacturer's product data shall be submitted for the following items:

Surge Arresters
Mounting Brackets

SD-08 Manufacturer's Instructions

Installation Instructions
Surge Arresters

SD-10 Operation and Maintenance Data

O & M Manuals
Surge Arresters

PART 2 PRODUCTS

2.1 EQUIPMENT

Design, fabrication, testing, and performance of arresters shall comply with IEEE C62.11, NEMA LA 1.

Arrester shall utilize metal oxide varistor and gapped arrester technologies.

The arresters shall be contained within a polymer housing. The arrester shall be designed to be non-fragmenting to provide extra safety to personnel and equipment. Arresters utilizing a hanger frame type mounting bracket, the frame shall be non-corrosive track resistant glass filled polyester or other suitable non-corrosive/non-conductive material providing high mechanical strength. Arrester mounting hardware shall be designed for installation in severe salt-spray atmosphere and shall be of a corrosion-resistant metal or shall be zinc-coated in accordance with ASTM A 123/A 123M, ASTM A 153/A 153M.

2.2 FABRICATION DRAWINGS

Submit fabrication drawings in accordance with paragraph entitled, "Equipment," of this section. Drawings shall show assembly and fabrication details performed in the factory.

2.3 SURGE ARRESTERS

2.3.1 O & M Manuals, Surge Arresters

Provide O & M Manuals for surge arresters specified within these plans and specifications.

2.3.2 Distribution

Distribution arresters shall be combination spark gap and metal oxide varistor type. Mounting hardware shall be corrosion resistant.

2.3.2.1 Distribution - Riser-Pole Class

Distribution - Riser-Pole Class shall be combination spark gap and metal oxide varistor type. Mounting hardware shall be corrosion resistant.

2.3.3 Intermediate

Arresters shall be single-phase, single-pole, self-supporting type for pedestal, platform, or bracket mounting.

2.3.4 Station

Arresters shall be single-phase, single-pole, self-supporting type for pedestal, platform, or bracket mounting.

2.4 SURGE PROTECTION FOR ROTATING AC MACHINES

Arresters installed on rotating alternating current equipment shall be the type and rating as recommended by the manufacturer of the equipment.

2.5 MOUNTING BRACKETS

Arresters shall be equipped with suitable mounting brackets for the applicable method of mounting.

PART 3 EXECUTION

3.1 INSTALLATION

Arresters shall be installed and connected in accordance with the manufacturer's installation instructions.

Ground connection shall be made to a driven ground rod, counterpoise, or station grounding system and shall meet the intent of the National Electrical Code, NFPA 70.

Lightning arresters shall be connected as close as practicable to the apparatus being protected. When connecting arresters to overhead conductors, a hot line clamp shall be used. The hot line clamp shall be so designed to be compatible to the type of conductor material being used, i.e. aluminum or copper.

3.1.1 Installation Instructions, Surge Arresters

Manufacturer's instructions shall be submitted for surge arresters including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and

safety precautions.

3.1.2 Installation Drawings

Submit installation drawings in accordance with paragraph entitled, "Installation," of this section.

3.2 ARRESTERS

3.2.1 Distribution Type

Distribution class arresters shall be installed on all overhead lines, riser poles, pad mounted transformers and where applicable installed on distribution load break switches, sectionalizers and fault interrupters.

3.2.1.1 Distribution - Riser-Pole Class

Distribution - Riser-Pole class arrestors shall be installed on all riser poles.

3.2.2 Intermediate Type

Install intermediate type arrestors on grounded support brackets/structures suitable to adequately support the weight of the arrestor.

3.2.3 Station Type

Install station type arrestors on grounded structures suitable to adequately support the weight of the arrestor.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.5	(1994) Aluminum Rigid Conduit-(ARC)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(2001) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C12.7	(1993) Watthour Meter Sockets (ANSI/IEEE)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA BU 1	(1999) Busways
NEMA C12.1	(2001) Electric Meters; Code for Electricity Metering
NEMA C80.1	(1994) Rigid Steel Conduit - Zinc Coated
NEMA C80.3	(1994) Electrical Metallic Tubing - Zinc Coated (EMT)
NEMA FU 1	(2002) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000) Industrial Control and Systems General Requirements
NEMA ICS 2	(2000) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts
NEMA ICS 3	(1993; R 2000) Industrial Control and System Factory Built Assemblies

NEMA ICS 4	(2000) Industrial Automation Control Products and Systems Section Terminal Blocks
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems, Enclosures
NEMA KS 1	(2001) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	(1998; R 2002) Motors and Generators
NEMA MG 10	(2001) Energy Management Guide for Selection and Use of Fixed Medium AC Squirrel Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2001) Energy Management Guide for Selection and Use of Single Phase Motors
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992; R 1997) Dry-Type Transformers for General Applications
NEMA TC 14	(2002) Filament-Wound Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(1999) PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA VE 1	(2002) Metal Cable Tray Systems
NEMA WD 1	(1999) General Color Requirements for Wiring Devices
NEMA WD 6	(2002) Wiring Devices - Dimensional Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 780	(2000) Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 1010	(1995; R 1999, Bul. 2002) Receptacle-Plug Combinations for Use in Hazardous

	(Classified) Locations
UL 1242	(2000; R 2001, Bul. 2002) Intermediate Metal Conduit
UL 1449	(1996; R 2002) Transient Voltage Surge Suppressors
UL 1561	(1999; R 2001) Dry-Type General Purpose and Power Transformers
UL 1660	(2000; R 2002, Bul. 2002) Liquid-Tight Flexible Nonmetallic Conduit
UL 1699	(1999; R 2002, Bul. 2002, 2003) Arc-Fault Circuit-Interrupters
UL 198C	(1986; R 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E	(1988; R 1988) Class R Fuses
UL 198H	(1988; R 1993) Class T Fuses
UL 20	(2000; R 2002, Bul. 2002) General-Use Snap Switches
UL 360	(1996; R 2001, Bul. 2002) Liquid-Tight Flexible Steel Conduit
UL 44	(1999; R 2002, Bul. 2002) Thermoset-Insulated Wires and Cables
UL 467	(1993; R 2001) Grounding and Bonding Equipment
UL 486A	(1997; R 2001, Bul. 2002, 2003) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; R 2001, Bul. 2002, 2003) Wire Connectors for Use with Aluminum Conductors
UL 486C	(2000; R 2002) Splicing Wire Connectors
UL 489	(2002; R 2002, Bul. 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(2001; R 2002) Attachment Plugs and Receptacles
UL 5	(1996; R 2001) Surface Metal Raceways and Fittings
UL 50	(1995; R 1999, Bul. 2001) Enclosures for Electrical Equipment
UL 506	(2000; Bul. 2002, 2003) Specialty

	Transformers
UL 508	(1999; R 2002, Bul. 2003) Industrial Control Equipment
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; R 2001, Bul. 2002) Metallic Outlet Boxes
UL 514B	(1997; R 2002, Bul. 2002) Fittings for Cable and Conduit
UL 514C	(1996; R 2002) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 5A	(1999; R 2002, Bul. 2002) Nonmetallic Surface Raceways and Fittings
UL 6	(2000; Bul. 2001, 2002) Rigid Metal Conduit- Steel
UL 651	(1995; R 2002) Schedule 40 and 80 Rigid PVC Conduit
UL 67	(1993; R 2002) Panelboards
UL 6A	(2000; Bul. 2002) Electrical Rigid Metal Conduit - Aluminum, Bronze, and Stainless Steel
UL 719	(2002) Nonmetallic-Sheathed Cables
UL 797	(2000; Bul. 2002) Electrical Metallic Tubing
UL 83	(1998; R 2001, Bul. 2002) Thermoplastic-Insulated Wires and Cables
UL 845	(1995; R 2002, Bul. 2003) Motor Control Centers
UL 854	(1999; R 2002) Service-Entrance Cables
UL 857	(2001; R 2002) Busways
UL 869A	(1998; Bul. 2002) Reference Standard for Service Equipment
UL 870	(1995; R 1999, Bul. 2002) Wireways, Auxiliary Gutters, and Associated Fittings
UL 886	(1994; R 1999, Bul. 2002) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	(1993; R 2002, Bul. 2002) Ground-Fault Circuit-Interrupters

UL 984 (1996; Bul. 2001) Hermetic Refrigerant Motor-Compressors

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Panelboards

Transformers

Busway

Cable trays

Motor control centers

Wireways

Load centers for housing units

SD-03 Product Data

Receptacles

Circuit breakers

Switches

Transformers

Enclosed circuit breakers

Motor controllers

Combination motor controllers

Manual motor starters

Metering

Meter base only

CATV outlets

Grounding Block

Surge protective devices

SD-06 Test Reports

600-volt wiring test

Grounding system test

Transformer tests

Ground-fault receptacle test

SD-07 Certificates

Fuses

SD-09 Manufacturer's Field Reports

Transformer factory tests

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5

Metering, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23, "Operation and Maintenance Data" and as specified herein.

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

NEMA C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2,UL 651, or fiberglass conduit, in accordance with NEMA TC 14.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, NEMA C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40 (40 mils thick).

2.2.6 Flexible Metal Conduit

UL 1.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steel, Die cast compression type.

2.2.7.3 Fittings for Use in Hazardous (Classified) Locations

UL 886.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3, UL 514B.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 SURFACE RACEWAY

2.3.1 Surface Metal Raceway

UL 5, two-piece painted steel, totally enclosed, snap-cover type. Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified herein and shall be spaced minimum of one every 18 inches. Alternate receptacles shall be wired on different circuits.

2.3.2 Surface Nonmetallic Raceway

UL 5A, nonmetallic totally enclosed, snap-cover type. Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified herein and shall be spaced minimum of one every 18 inches. Alternate receptacles shall be wired on different circuits.

2.4 BUSWAY

NEMA BU 1, UL 857. Buses shall be copper. Busways shall be rated as indicated on shop drawings and include integral or internal 50-percent ground bus. Short circuit rating shall be as indicated on shop drawings root mean square (rms) symmetrical amperes minimum as indicated. Busway systems shall be suitable for use indoors. Enclosures shall be steel, aluminum, metallic. Hardware shall be plated or otherwise protected to resist corrosion. Joints shall be one-bolt type with through-bolts, which can be checked for tightness without deenergizing system. Maximum hot spot temperature rise at any point in busway at continuous rated load shall not exceed 55 degrees C above maximum ambient temperature of 40 degrees C in any position. Provide internal barriers to prevent movement of superheated gases. Contractor shall coordinate proper voltage phasing of entire bus duct system, for example where busway interfaces with transformers, switchgear, switchboards, motor control centers, and other system components.

2.4.1 Feeder Busways

Provide ventilated, except that vertical busways within 6 feet of floors shall be unventilated, unventilated, totally enclosed low-impedance busway. Bus bars shall be fully insulated from one another, except at stabs. Entire busway system shall be polarized.

2.4.2 Plug-In Busways

Unventilated type. Plug-in units shall be fusible, handle-operated, switch type, horsepower-rated circuit breaker-type, handle-operated, switch type, equipped with high interrupting-capacity, current-limiting fuses. A hook stick of suitable length shall be provided for operating plug-in units from the floor. Bus bars shall have insulating sleeving entire length, except at joints.

2.5 CABLE TRAYS

NEMA VE 1. Cable trays shall form a wireway system, and shall be of

nominal 3, 4, 6 inch depth. Cable trays shall be constructed of aluminum, copper-free aluminum, steel that has been zinc-coated after fabrication. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 12, 24, 36 inches. Radius of bends shall be as indicated.

2.5.1 Trough-Type Cable Trays

Sized as indicated Of nominal 6, 12, 18, 24, 30, 36 inch width.

2.5.2 Ladder-Type Cable Trays

Sized as indicated Of nominal 6, 12, 18, 24, 30, 36 inch width with maximum rung spacing of 6, 9, 12, 18 inches.

2.5.3 Channel-Type Cable Trays

Sized as indicated 3, 4, 6 inches wide. Trays shall be one-piece construction having slots spaced not more than 4 1/2 inches on centers.

2.5.4 Solid Bottom-Type Cable Trays

Sized as indicated Nominal 6, 12, 18, 24, 30, 36 inch width.

2.6 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.6.1 Outlet Boxes in Hazardous (Classified) Locations

UL 886.

2.6.2 Floor Outlet Boxes

Boxes shall be adjustable and concrete tight. Each outlet shall consist of nonmetallic or cast-metal body with threaded openings, or sheet-steel body with knockouts for conduits, adjustable ring, brass flange ring, and cover plate with 3/4, 1, 1 1/4, 2 1/8 inch threaded plug. Telephone outlets shall consist of surface-mounted, horizontal, flush, aluminum or stainless steel housing with one inch bushed side opening, 3/4 inch top opening; telephone outlets shall have provisions to accommodate 10-wire telephone terminal block. Receptacle outlets shall consist of surface-mounted, horizontal, flush aluminum or stainless steel housing with duplex-type receptacle as specified herein. Provide gaskets where necessary to ensure watertight installation.

2.6.3 Clock Outlet for Use in Other Than Wired Clock System

Provide outlet box with plastic cover, where required, and single receptacle with clock outlet plate. Receptacle shall be recessed sufficiently within box to allow complete insertion of standard cap, flush with plate. Suitable clip or support for hanging clock shall be secured to top plate. Material and finish of plate shall be as specified in paragraph entitled "Device Plates" of this section.

2.7 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.8 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.8.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper. Conductors indicated to be No. 6 AWG or smaller diameter shall be copper. Conductors indicated to be No. 4 AWG and larger diameter shall be copper, unless type of conductor material is specifically indicated, or specified, or required by equipment manufacturer.

2.8.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.8.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.8.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

d. On three-phase, four-wire delta system, high leg shall be orange, as required by NFPA 70.

2.8.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83 or Type XHHW or RHW conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.8.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.8.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.8.6 Nonmetallic Sheathed Cable

UL 719, Type NM or NMC.

2.8.7 Wire and Cable for 400 Hertz (Hz) Circuits

Insulated copper conductors.

2.8.8 Mineral-Insulated, Metal-Sheathed Cable

UL listed; NFPA 70, Type MI cable. Sheathing containing asbestos fibers shall not be used.

2.8.9 Flat Conductor Cable

UL listed; NFPA 70, Type FCC.

2.8.10 Cable Tray Cable

UL listed; type TC.

2.9 SPLICES AND TERMINATION COMPONENTS

UL 486A and UL 486B, as applicable, for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.10 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be nylon or lexan, minimum 0.03 inch wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations." Device plates in areas normally accessible to prisoners shall be brown or ivory finish nylon-device plates rated for high abuse. Test device plates for compliance with UL 514A and UL 514C for physical strength. Attach device plates with spanner head bolts.

2.11 SWITCHES

2.11.1 Toggle Switches

NEMA WD 1, UL 20, single pole, double pole, three-way, and four-way, totally enclosed with bodies of thermoplastic and/or thermoset plastic and mounting strap with grounding screw. Handles shall be white, ivory, brown thermoplastic. Wiring terminals shall be screw-type, side-wired. Contacts shall be silver-cadmium and contact arm shall be one-piece copper alloy. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.11.2 Switch with Red Pilot Handle

NEMA WD 1. Provide pilot lights that are integrally constructed as a part of the switch's handle. The pilot light shall be red and shall illuminate whenever the switch is closed or "on". The pilot lighted switch shall be rated 20 amps and 120 volts or 277 volts as indicated. Provide the circuit's neutral conductor to each switch with a pilot light.

2.11.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 1, 3R, enclosure as indicated per NEMA ICS 6.

2.11.4 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.12 RECEPTACLES

UL 498, hard use, heavy-duty, UL 498, hospital grade, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of white, ivory, brown as per NEMA WD 1. Face and body shall be thermoplastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect

grounding pole to mounting strap. The receptacle shall contain triple-wipe power contacts and double or triple-wipe ground contacts.

2.12.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle shall be switched when installed.

2.12.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.12.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI, GFI devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.12.4 Receptacles in Hazardous (Classified) Locations

UL 1010

2.12.5 Special Purpose Receptacles

Receptacles serving _____ are special purpose. Provide in ratings indicated. NEMA configuration, as indicated on plans. Furnish one matching plug with each receptacle.

2.12.6 Plugs

Provide heavy-duty, rubber-covered three-, four-, or five-wire cord of required size, install plugs thereon, and attach to equipment. Plugs shall be UL listed with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the Government.

2.12.7 Range Receptacles

NEMA 14-50 configuration, flush mounted for housing units, rated 50 amperes, 125/250 volts. Furnish one matching plug with each receptacle.

2.12.8 Dryer Receptacles

NEMA 14-30 configuration, rated 30 amperes, 125/250 volts. Furnish one matching plug with each receptacle.

2.12.9 Tamper-Resistant Receptacles

Provide duplex receptacle with mechanical sliding shutters that prevent the insertion of small objects into its contact slots.

2.13 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated of 10,000 amperes symmetrical minimum. Panelboards for use as service

disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped unless indicated otherwise. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" or "below" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). Provide new directories for existing panels modified by this project as indicated. Type directories and mount in holder behind transparent protective covering. Panelboards shall be listed and labeled for their intended use.

2.13.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet. In addition to equipment grounding bus, provide second "isolated" ground bus, where indicated.

2.13.1.1 Panelboard Neutrals for Non-Linear Loads

UL listed, and panelboard type shall have been specifically UL heat rise tested for use on non-linear loads. Panelboard shall be heat rise tested in accordance with UL 67, except with the neutral assembly installed and carrying 200 percent of the phase bus current during testing. Verification of the testing procedure shall be provided upon request. Two neutral assemblies paralleled together with cable is not acceptable. Nameplates for panelboard rated for use on non-linear loads shall be marked "SUITABLE FOR NON-LINEAR LOADS." Provide a neutral label with instructions for wiring the neutral of panelboards rated for use on non-linear loads.

2.13.2 Circuit Breakers

UL 489, thermal magnetic-type solid state-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers without a self-contained bracket and not secured by a positive locking device requiring mechanical release for removal are unacceptable. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.13.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.13.2.2 Circuit Breaker With GFCI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFCI, GFI devices, for personnel protection, and 20 milliamperes or greater per requirements of UL 943 for Class B GFCI per equipment protection.

2.13.2.3 Circuit Breakers for HVAC Equipment

Circuit breakers for HVAC equipment having motors (group or individual) shall be marked for use with HACR type and UL listed as HACR type.

2.13.2.4 Arc-Fault Circuit-Interrupters

UL 489, UL 1699 and NFPA 70. Molded case circuit breaker shall be rated as indicated. Two pole arc-fault circuit-interrupters shall be rated 120/240 volts. The provision of (two) one pole circuit breakers for shared neutral circuits in lieu of (one) two pole circuit breaker is unacceptable. Provide with "push-to-test" button.

2.13.3 Fusible Switches for Panelboards

NEMA KS 1, hinged door-type. Switches serving as motor disconnect means shall be horsepower rated.

2.13.4 400 Hz Panelboard and Breakers

Panelboards and breakers for use on 400 Hz systems shall be "400 Hz" rated and labeled.

2.14 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral.

2.15 MOTOR CIRCUIT PROTECTORS (MCP)

Motor circuit protectors; UL 489. MCPs shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short circuit protection. MCPs shall be rated in accordance with NFPA 70.

2.16 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch, panel and control center. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation. Submit coordination data for approval. Fuses shall have voltage rating not less than circuit voltage.

2.16.1 Cartridge Fuses, Current Limiting Type (Class R)

UL 198E, Class RK-1, RK-5 time-delay type. Associated fuseholders shall be Class R only.

2.16.2 Cartridge Fuses, Current Limiting Type (Classes J, L, and CC)

UL 198C, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.16.3 Cartridge Fuses, Current Limiting Type (Class T)

UL 198H, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.17 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated, unventilated, sealed. Provide transformers in NEMA 1, 3R enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 150, 115, 80 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating. Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating. Transformer of 80 degrees C temperature rise shall be capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.17.1 Transformers With Non-Linear Loads

Transformer insulation shall be a UL recognized 220 degrees C system. Neither the primary nor the secondary temperature shall exceed 220 degrees C at any point in the coils while carrying their full rating of non-sinusoidal load. Transformers are to be UL listed and labeled for K-4, K-13 as indicated, defined as the sum of fundamental and harmonic lh(pu)2h2 per UL 1561. Transformers evaluated by the UL K-Factor evaluation shall be listed for 115 degrees C, 80 degrees C average temperature rise only. Transformers with K-Factor ratings with temperature rise of 150 degrees C rise shall not be acceptable. K-Factor rated transformers shall have an impedance range of 3 percent to 5 percent, and shall have a minimum reactance of 2 percent to prevent excessive neutral current when supplying loads with large amounts of third harmonic.

2.18 MOTORS

NEMA MG 1 except fire pump motors shall be as specified in Section 21 30 00 "Fire Pumps"; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Provide motors in hazardous locations with classifications as indicated.

2.18.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

2.18.2 High Efficiency Polyphase Motors

Polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-10 of NEMA MG 1.

2.18.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.19 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2, except fire pump controllers shall be as specified in Section 21 30 00, "Fire Pumps". Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. Minimum short circuit withstand rating of combination motor controller shall be _____ rms symmetrical amperes. Provide controllers in hazardous locations with classifications as indicated.

2.19.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded. For designated systems, as indicated, provide backup power supply, including transformers connected to emergency power source. Provide for automatic switchover and alarm upon failure of primary control circuit.

2.19.2 Enclosures for Motor Controllers

NEMA ICS 6.

2.19.3 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.19.4 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.19.5 Pilot and Indicating Lights

Provide transformer, resistor, or diode type. Provide LED cluster lamps.

2.19.6 Terminal Blocks

NEMA ICS 4.

2.19.7 Reduced-Voltage Controllers

Provide for polyphase motors as indicated on drawings. Reduced-voltage starters shall be single-step, closed transition autotransformer, reactor, primary resistor-type, solid state-type, or as indicated, and shall have adjustable time interval between application of reduced and full voltages to motors. Wye-delta reduced voltage starter or part winding increment starter having adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced-voltage starters for starting of motor-generator sets, centrifugally operated equipment, or reciprocating compressors provided with automatic unloaders.

2.20 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single, Double, Three pole designed for flush, surface mounting with overload protection and pilot lights.

2.20.1 Pilot Lights

Provide yoke-mounted, candelabra-base sockets rated 125 volts and fitted

with glass or plastic jewels. Provide clear, 6 watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green; jewels for other purposes shall be white, red, amber. Provide yoke-mounted, seven element LED cluster light module. Color shall be green, red, amber, in accordance with NEMA ICS 2.

2.21 MOTOR CONTROL CENTERS

UL 845, NEMA ICS 2, NEMA ICS 3. Wiring shall be Class I, II, Type A, B, C, in NEMA Type 1, 3R, 12 enclosure. Provide control centers suitable for operation on _____-volt, _____-phase, _____-wire, _____ Hz system and shall have minimum short-circuit withstand and interrupting rating of 100,000, 65,000, 42,000, 25,000 amperes rms symmetrical. Incoming power feeder shall be bus duct, cable entering at the top, bottom of enclosure and terminating on terminal lugs, main protective device. Main protective device shall be molded case circuit breaker, low-voltage power circuit breaker, fusible switch, rated as indicated on drawings. Arrange busing so that control center can be expanded from both ends. Interconnecting wires shall be copper. Terminal blocks shall be plug-in-type so that controllers may be removed without disconnecting individual control wiring.

2.21.1 Bus Systems

Provide the following bus systems. Power bus shall be braced to withstand fault current of 100,000, 65,000, 42,000, 25,000 amperes rms symmetrical. Wiring troughs shall be isolated from horizontal and vertical bus bars.

2.21.1.1 Horizontal and Main Buses

Horizontal bus shall have continuous current rating of 800, 600, 1000, 1200 amperes. Main bus shall be aluminum, tin-plated copper, silver-plated enclosed in isolated compartment at top of each vertical section. Main bus shall be isolated from wire troughs, starters, and other areas.

2.21.1.2 Vertical Bus

Vertical bus shall have continuous current rating of 450, 300, 600, amperes, and shall be copper, tin-plated copper, silver-plated. Vertical bus shall be enclosed in flame-retardant, polyester glass "sandwich."

2.21.1.3 Ground Bus

Copper ground bus shall be provided full width of motor control center and shall be equipped with necessary lugs.

2.21.1.4 Neutral Bus

Insulated neutral bus shall be provided continuous through the motor control center; neutral shall be full rated. Lugs of appropriate capacity shall be provided, as required.

2.21.2 Motor Disconnecting Devices and Controllers

Shall comply with paragraph entitled "Combination Motor Controllers."

2.21.3 Combination Motor Controllers

UL 508 and other requirements in paragraph entitled, "Motor Controllers." Controller shall employ molded case circuit breaker. Circuit breakers for

combination controllers shall be thermal magnetic.

2.22 TELEPHONE SYSTEM

Provide system of telephone wire-supporting structures, including: conduits with pull wires and wireways, cable trays, terminal boxes, outlet and junction boxes, other accessories for telephone outlets, and telephone cabinets wire closets backboards. Additional requirements are in Section 27 10 00, "Structured Telecommunications Cabling and Pathway System."

2.22.1 Outlet Boxes for Telephone System

Standard type, as specified herein, 4 by 4 in. Mount flush in finished walls at height specified for outlet receptacles. Outlet boxes for wall-mounted telephones shall be 2 by 4 by 2 1/8 in deep; mounted at height 60 in above finished floor. Outlet boxes for handicapped telephone station shall be 2 by 4 by 2 1/8 in deep and mounted at height 48 in above finished floor.

2.22.2 Cover Plates

Modular telephone type with same finish specified for receptacle and switch cover plates.

2.22.3 Conduit Sizing

Conduit for single outlets shall be minimum of 1 in and for multiple outlets minimum of one inch. Size conduits for telephone risers to telephone cabinets, junction boxes, distribution centers, and telephone service, as indicated.

2.22.4 Backboards

Interior grade plywood, 3/4 in thick, 4 by 8 ft minimum size as indicated. Paint with gray fire resistant paint.

2.22.5 Terminal Cabinets

Construct of zinc-coated sheet steel. Cabinets shall be constructed with interior dimensions not less than those indicated. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum-size openings to the box interiors. Boxes shall be provided with 5/8 in backboard having a two-coat insulating varnish finish. Match trim, hardware, doors, and finishes to lighting panelboards.

2.22.6 Receptacles for Telephone Service

Provide receptacles, 125 volts, 20 amperes, single phase, 60 Hz _____, adjacent to telephone backboards, served from dedicated panelboard circuits.

2.23 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be sectional type, copper-clad steel, with minimum diameter of 3/4 in and minimum length of 10 ft, of 20 ft.

2.24 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70, shall be specifically approved by

Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations shall be as indicated.

2.25 NAMEPLATES

Provide as specified in Section 26 00 00, "Basic Electrical Materials and Methods."

2.26 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, "Firestopping."

2.27 WIREWAYS

UL 870. Material shall be steel epoxy painted galvanized 16 gage for heights and depths up to 6 by 6 in, and 14 gage for heights and depths up to 12 by 12 in. Provide in length indicated, required for the application with hinged- screw- cover NEMA 1, 3R, 12 enclosure per NEMA ICS 6.

2.28 METERING

NEMA C12.1. Provide a self-contained, socket-mounted, electronic programmable outdoor watthour meter. Meter shall either be programmed at the factory or shall be programmed in the field. Turn field programming device over to the Contracting Officer at completion of project. Meter shall be coordinated to system requirements.

a. Design: Provide watthour meter designed for use on a single-phase, three-wire, 240/120, 480/240 volt system. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).

b. Class: 200; Form: 2S, accuracy: +/- 1.0 percent; Finish: Class II

c. Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

d. Kilowatt-hour Register: five digit electronic programmable type

e. Demand Register:

(1) Provide solid state.

(2) Meter reading multiplier: Indicate multiplier on the meter face.

(3) Demand interval length: Shall be programmed for 15, 30, 60 minutes with rolling demand up to six subintervals per interval.

f. Socket: IEEE C12.7. Provide NEMA Type 3R, box-mounted socket, ringless, having manual circuit-closing bypass and having jaws compatible with requirements of the meter. Provide manufacturers standard enclosure color unless otherwise indicated.

2.29 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices which comply with UL 1449 at the service entrance, panelboards, MCC. Provide surge protectors in a NEMA 3R enclosure per NEMA ICS 6. Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-
Each phase to neutral (L-N)
Neutral to ground (N-G)
Phase to ground (L-G)

FOR DELTA CONNECTIONS-
Phase to phase (L-L)
Phase to ground (L-G)

Surge protective devices at the service entrance shall have a minimum surge current rating of 80,000 amperes per mode minimum and downstream protectors shall be rated 40,000 amperes per mode minimum. The maximum line to neutral (L-N) Suppressed Voltage Rating (SRV) shall be:

500V for 120V, single phase system
500V for 120/240V, single phase system
500V for 208Y/120V, three phase system
900V for 480Y/277V, three phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating shall be:

150V for 120V, single phase system
300/150V for 120/240V, single phase system
300/150V for 208Y/120V, three phase system
600/320V for 480Y/277V, three phase system

EMI/RFI filtering shall be provided for each mode with the capability to attenuate high frequency noise. Minimum attenuation shall be 20db.

2.30 SOURCE QUALITY CONTROL

2.30.1 Transformer Factory Tests

Submittal shall include routine NEMA ST 20 transformer test results on each transformer and also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Overhead Service

Overhead service conductors into buildings shall terminate at service entrance fittings or weatherhead outside building. Overhead service conductors and support bracket for overhead conductors are included in the Section 33 71 01, "Overhead Transmission and Distribution."

3.1.3 Hazardous Locations

Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.

3.1.4 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.4.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 in in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.5 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters. Minimum conduit size shall be 1/2 in in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 in. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped in accordance with Section 07 84 00, "Firestopping".

3.1.5.1 Restrictions Applicable to Aluminum Conduit

Do not install underground or encase in concrete or masonry. Do not use brass or bronze fittings.

3.1.5.2 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious

materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

3.1.5.3 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

3.1.5.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.5.5 Service Entrance Conduit, Overhead

Rigid steel or IMC from service entrance to service entrance fitting or weatherhead outside building.

3.1.5.6 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 in of concrete and shall be installed minimum 24 in below slab or grade.

3.1.5.7 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 in above floor.

3.1.5.8 Conduit in Floor Slabs

Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40. PVC, Type EPC-40, unless indicated otherwise.

3.1.5.9 Conduit Interior to Buildings for 400 Hz Circuits

Aluminum or nonmetallic. Where 400-Hz circuit runs underground or through concrete, conduit shall be PVC Schedule 40, 80.

3.1.5.10 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.1.5.11 Flat Conductor Cable

Install in accordance with NFPA 70, Type FCC cable.

3.1.6 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 in away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits in crawl space, under floor slab as if exposed.

3.1.6.1 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 in below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.6.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.6.3 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 in in reinforced concrete beams or to depth of more than 3/4 in in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10 ft maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity

by bonding jumpers or other means. For conduits greater than 2 1/2 in inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.6.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.6.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-lb tensile strength. Leave minimum 36 in of slack at each end of pull wire.

3.1.6.6 Telephone and Signal System Conduits

Refer to Section 27 10 00, "Structured Telecommunications Cabling and Pathway System."

3.1.6.7 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.6.8 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 in above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.6.9 Flexible Connections

Provide flexible steel conduit between 3 and 6 ft in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 in diameter. Provide liquidtight flexible nonmetallic conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.7 Busway Installation

Installation shall comply at minimum with NFPA 70. Install busways parallel with or at right angles to ceilings, walls, and structural members. Support busways at 5 ft maximum intervals, and brace to prevent

lateral movement. Hinges provided on risers shall be fixed type; spring-type are unacceptable. Provide flanges where busway makes penetrations through walls and floors, and seal to maintain smoke and fire ratings. Provide waterproof curb where busway riser passes through floor. Seal gaps with fire-rated foam and calk. Provide expansion joints, but only where bus duct crosses building expansion joints. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.8 Cable Tray Installation

Install and ground per NFPA 70, Article 318. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support in accordance with manufacturer recommendations but at not more than 6 ft intervals as indicated. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. For grounding of cable tray system provide No. 2 AWG bare copper wire throughout cable tray system, and bond to each section, except use No. 1/0 aluminum wire if cable tray is aluminum. Terminate cable trays 10 in from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 in rigid steel conduits with grounding bushings, extending 12 in beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Penetrations shall be firestopped in accordance with Section 07 84 00, "Firestopping." Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.9 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 ft above floors and walkways, or when installed in hazardous areas and when specifically indicated. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic sheathed cable conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 in square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support

sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 in from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.9.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 in deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 in square, except that 4 by 2 in boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 4 in square by 2 1/8 in deep , except for wall mounted telephones and outlet boxes for handicap telephone stations.

3.1.9.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.9.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.10 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 in above floor. Mount lighting switches 48 in above finished floor, receptacles 18 in above finished floor unless otherwise indicated, and other devices as indicated. Measure mounting heights of wiring devices and outlets in non-hazardous areas to center of device or outlet. Measure mounting heights of receptacle outlet boxes in the hazardous area 46-inches to the bottom of the outlet box.

3.1.11 Nonmetallic Sheathed Cable Installation

Where possible, install cables concealed behind ceiling or wall finish. Thread cables through holes bored on approximate centerline of wood members; notching of end surfaces is not permitted. Provide sleeves through concrete or masonry for threading cables. Install exposed cables parallel to or at right angles to walls or structural members. Protect exposed nonmetallic sheathed cables less than 4 ft above floors from mechanical injury by installation in conduit or tubing. When cable is used in metal stud construction, insert plastic stud grommets in studs at each point through which cable passes, prior to installation of cable.

3.1.12 Mineral Insulated, Metal Sheathed (Type MI) Cable Installation

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes shall be not less than those indicated for the conduit installation. Cables shall be fastened

within 12 in of each turn or offset and at 33 in maximum intervals. Make cable terminations in accordance with NFPA 70 and cable manufacturer's recommendations. Single-conductor cables of a circuit, having capacities of more than 50 amperes, shall terminate in a single box or cabinet opening. Individual conductors in all outlets and cabinets shall be color-coded.

3.1.13 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 23 09 53.00 20, "Space Temperature Control Systems." Section _____, "_____" Section 23 09 54, "Direct Digital Control Systems"manufacturer's recommendations.

3.1.14 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.15 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 in. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.16 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00, "Firestopping."

3.1.17 Grounding and Bonding

In accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, access flooring support system, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telephone system grounds, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include lightning protection, electrical service, telephone system grounds, as well as underground metallic piping systems. Interconnection to the gas line shall

be made on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.17.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.17.2 Telephone Service

Provide main telephone service equipment ground consisting of separate ground wire, No. 6 AWG the same size as the Class I lightning protection system main conductor or No. 6 AWG, whichever is larger, in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.18 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.19 Elevator

Connections to the elevator shall include: (1) per NFPA 70, Article 620, provision of 120 volt, 20 ampere circuit (including circuit protection, conduit and wires) from the indicated panel to elevator machine room; terminate circuit in 120 volt, 30 ampere, 2 pole fused disconnect switch in elevator machine room. (2) in the elevator pit, provision of light fixture, with light switch adjacent to point of access, and 20 ampere duplex receptacle (weatherproof); serve from circuits as indicated.

3.1.20 Government-Furnished Equipment

Contractor shall rough-in for Government-furnished equipment shall make connections to Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.21 Repair of Existing Work

Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

3.1.21.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping,

and equipment using skilled craftsmen of trades involved.

3.1.21.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.21.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.

3.1.21.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

3.1.22 Watthour Meters

NEMA C12.1.

3.1.23 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 15 working days notice prior to each tests.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.2.4 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

3.2.6 Watthour Meter

a. Visual and mechanical inspection

(1) Examine for broken parts, shipping damage, and tightness of connections.

(2) Verify that meter type, scales, and connections are in accordance with approved shop drawings.

b. Electrical tests

(1) Determine accuracy of meter.

(2) Calibrate watthour meters to one-half percent.

(3) Verify that correct multiplier has been placed on face of meter, where applicable.

-- End of Section --

SECTION 26 32 13

SINGLE OPERATION GENERATOR SETS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(1998) Malleable Iron Threaded Fittings Classes 150 and 300
ASME B16.5	(1996; Addenda 1998) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.9	(2001) Factory-Made Wrought Buttwelding Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 126	(1995; R 2001) Gray Iron Castings for Valves, Flanges, and Pipe Fittings E1-1998
ASTM A 181/A 181M	(2001) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 193/A 193M	(2001; Rev. B) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(2001; Rev. A) Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A 234/A 234M	(2002) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM D 975	(2002) Diesel Fuel Oils

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-52557 (1996) Fuel Oil, Diesel; for Posts, Camps and Stations

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC (1997) Uniform Building Code

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60034-2 (1972; Sup. A 1974, Amend. 1995 & 1996)Rotating Electrical Machines Part 2: Methods for Determining Losses and Efficiency of Rotating Electrical Machinery from Tests (Excluding Machines for Traction Vehicles)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 115 (1995; R 2002) Test Procedures for Synchronous Machines Part 1 - Acceptance and Performance Testing Part II - Test Procedures and Parameter Determination for Dynamic Analysis

IEEE C2 (2002) National Electrical Safety Code (IEEE)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 3046 (2002) Reciprocating Internal Combustion Engines - Performance

ISO 8528 (1993) Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-5624 (1998; Rev. T) Turbine Fuel, Aviation, Grades JP-4, JP-5, and JP-5/JP-8 ST

MIL-PRF-16884 (2002; Rev. K) Fuel, Naval Distillate

MIL-STD-461 (1999; Rev. E) Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (2002) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and

Threaded Ends

MSS SP-71 (1997) Cast Iron Swing Check Valves, Flanged and Threaded Ends

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

MSS SP-85 (2002) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C50.10 (1990) Rotating Electrical Machinery - Synchronous Machines

NEMA C50.12 (1982; R 1989) Salient-Pole Synchronous Generators and Generator/Motors for Hydraulic Turbine Applications

NEMA ICS 6 (1993; R 2001) Industrial Control and Systems Enclosures

NEMA MG 1 (1998; Rev. 2002) Motors and Generators

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (2000) Flammable and Combustible Liquids Code

NFPA 37 (2002) Installation and Use of Stationary Combustion Engines and Gas Turbines

NFPA 70 (2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 142 (2002) Steel Aboveground Tanks for Flammable and Combustible Liquids

UL 429 (1999; R 2001, Bul. 2002) Electrically Operated Valves

UL 467 (1993; R 2001) Grounding and Bonding Equipment

UL 489 (2002; R 2002, Bul. 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 1236 (2002) Battery Chargers For Charging Engine Starter Batteries

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," and Section 26 08 00, "Apparatus Inspection and Testing" apply to this section except as modified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Engine-Generator Set Data

Submit data pertaining to the diesel engine-generator set and to the auxiliary equipment including but not limited to the following:

a. Make of engine.

b. Type or model of engine.

c. Gross bhp rating of engine shall be the total rated power output before deducting power requirements of electric motor-driven equipment or engine driven radiator fan.

d. Net brake power rating of engine shall include deductions for the total power requirements of electric motor-driven or engine-driven accessories as defined in ISO 3046. Net ratings shall include a deduction in power output for cooling media system power requirements including radiator fans and any other power consuming devices required to provide cooling as specified.

e. Strokes per cycle.

f. Number of cylinders.

g. Bore and stroke, inches.

h. Engine speed, rpm.

i. Piston speed, fpm.

j. kW power rating of engine-generator set as defined in the paragraph entitled "Engine-Generator Set Ratings and Performance."

k. Induction method (naturally aspirated, turbocharged).

l. Intercooler type (air-to-air or jacket water).

m. Governor type, make, and model.

n. Make and model of turbochargers.

1.3.2 Engine-Generator Set Efficiencies

Submit data pertaining to the diesel engine-generator set including but not limited to the following: Loads shall be calculated on basis of rated engine-generator set power.

a. Fuel consumption at 0.80 power factor, gallons per hr.

1. 1/2 load

2. 3/4 load

3. Full load

b. Generator efficiency at 0.80 power factor (percent) in accordance with IEC 60034-2.

1. 1/2 load

2. 3/4 load

3. Full load

c. Radiator capacity at design conditions.

1. Coolant shall be antifreeze mixture as specified under paragraph entitled "Cooling System."

2. gpm of coolant

3. cfm of air through radiator

4. Btu per hr of heat exchange based on optimum coolant temperature to and from engine.

1.3.3 Diesel Engine Data

Submit data certified by the engine manufacturer including but not limited to the following: Loads shall be calculated on basis of rated engine-generator set power.

a. Approximate exhaust temperature degrees F at full load

1.3.4 Generator and Exciter Data

Submit data certified by the generator manufacturer including but not limited to the following:

a. Make and model number of generator

b. kW rating of generator

c. Generator reactances

1. Synchronous reactance, Xd

2. Transient reactance, X'd

3. Subtransient reactance, X"d

4. Negative sequence reactance, X2

5. Zero sequence reactance, Xo

1.3.5 Capacity Calculations for Engine-Generator Set

Calculations shall verify that the engine-generator set power rating is adequate for the load described in the paragraph entitled "Load Profile."

1.3.6 Calculations for Brake Mean Effective Pressure (BMEP)

Calculation shall verify that the diesel engine meets the specified maximum BMEP as follows:

a. kW: Minimum power rating of engine-generator set as defined in the paragraph entitled "Engine-Generator Set Ratings and Performance."

b. rpm: Engine revolutions per minute.

c. cu. in.: Total engine piston displacement in cubic inches.

d. GEN.EFF.: Generator efficiency.

e. x: Multiplication sign.

f. bhp': Brake horsepower required from diesel engine by generator loaded to full power rating.

g. bhp': kW/(GEN.EFF. x 0.746).

h. bhp": Brake horsepower required by diesel engine driven fan for cooling radiator or motor driven fan for cooling radiator.

i. bhp: bhp' + bhp".

j. BMEP psi: (792,000 x bhp) /(rpm x cu. in.).

1.3.7 Torsional Vibration Stress Analysis Computations

Torsional vibrational stresses in the crankshaft and generator shaft of assembled diesel engine and driven generator shall not exceed 5000 psi when engine is driving generator at rated speed while assembled unit is loaded to rated engine-generator set power. Computations shall be based on a mathematical model of the assembled generator set provided or based on calculations using measured values from tests on a unit identical to the one provided. Calculations based on models of, or measured data from, the unassembled engine and generator will not be acceptable. Calculations shall include:

a. A description of the system relating information pertinent to analysis such as operating speed range and identification plate data.

b. A mass elastic assembly drawing, showing the arrangement of the units in the generator set and dimensions of shafting, including minimum diameters (or section moduli) of shafting in the system.

c. A labeled line diagram of the mass elastic system indicating values of masses, stiffness, equivalent lengths, and equivalent diameters including basic assumptions and definition of terms.

d. Sample computations showing procedures used to obtain resulting stress values.

e. Computations indicating assembled engine-generator speed of 1800 rpm with assembly loaded to rated generator power and the resulting computed critical torsional stress values in the assembled engine crankshaft and generator shaft.

1.3.8 Capacity Calculations for Batteries

Calculation shall verify that the engine starting battery capacity exceeds dc power requirements.

1.3.9 Turbocharger Load Calculations

When the proposed exhaust system layout is different from that shown on the contract drawings, submit calculations showing that the external loads from the exhaust system such as weight and thermal expansion do not exceed the engine manufacturer's maximum allowed forces and moments on the turbocharger.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Engine-Generator set and auxiliary equipment

Auxiliary systems

SD-03 Product Data

Engine-generator set data

Engine-generator set efficiencies

Diesel engine data

Generator and exciter data

Diesel engine-generator set

Auxiliary systems and equipment

Remote alarm annunciator

SD-05 Design Data

Capacity calculations for engine-generator set

Calculations for brake mean effective pressure

Torsional vibration stress analysis computations

Capacity calculations for batteries

Turbocharger load calculations

SD-06 Test Reports

Acceptance checks and tests

Functional acceptance tests

Functional acceptance test procedure

SD-07 Certificates

Vibration isolation system certification

Fuel system certification

Start-up engineer qualification resume

Instructor's qualification resume

SD-09 Manufacturer's Field Reports

Engine tests

Generator tests

Assembled engine-generator set tests

SD-10 Operation and Maintenance Data

Diesel engine-generator set, Data Package 4

Auxiliary systems and equipment, Data Package 4

Preliminary assembled operation and maintenance manuals

Submit operation and maintenance manuals in accordance with Section 01 78 23, "Operation and Maintenance Data" and the paragraph entitled "Assembled Operation and Maintenance Manuals."

SD-11 Closeout Submittals

Posted operating instructions

Training plan

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Engine-Generator Set and Auxiliary Equipment

Submit drawings pertaining to the engine-generator set and auxiliary equipment, including but not limited to the following:

a. Certified outline, general arrangement (setting plan), and anchor bolt details. Show total weight and center of gravity of assembled equipment on the steel subbase.

b. Detailed elementary, schematic wiring, and interconnection diagrams of the engine starting system, jacket coolant heating system, engine protective devices, engine alarm devices, engine speed governor system, generator and excitation system, and other integral devices.

c. Detailed elementary, schematic wiring; and interconnection diagrams of the diesel fuel system, starting battery system, engine-generator control panel, generator circuit breaker, and remote alarm annunciator.

d. Dimensional drawings or catalog cuts of exhaust silencers, radiator, diesel fuel day tanks, fuel oil cooler, valves and pumps, intake filters, vibration isolators, and other auxiliary equipment not integral with the engine-generator set.

1.5.1.2 Auxiliary Systems

Submit drawings showing floor plan arrangement of exhaust, air intake, fuel oil cooler, and jacket coolant water systems including arrangement of piping and pipe sizes.

1.5.2 Vibration Isolation System Certification

Submit certification from the manufacturer that the vibration isolation system will reduce the vibration to the limits specified in the paragraph entitled "Vibration Isolation System."

1.5.3 Fuel System Certification

When the diesel fuel system requires a fuel oil cooler as described in the paragraph entitled "Fuel Oil Cooler," submit certification from the engine manufacturer that the fuel system design is satisfactory.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver equipment on pallets or blocking wrapped in heavy-duty plastic, sealed to protect parts and assemblies from moisture and dirt. Plug piping, conduit, exhaust, and air intake openings. Protect and prepare batteries for shipment as recommended by the battery manufacturer. Store auxiliary equipment at the site in covered enclosures, protected from atmospheric moisture, dirt, and ground water.

1.7 SITE CONDITIONS

Protect the components of the engine-generator set, including cooling system components, pumps, fans, and similar auxiliaries when not operating and provide components capable of the specified outputs in the following environment:

a. Site Location: Sub-tropical, coastal area

b. Site Elevation: Mean sea level

c. Ambient Temperatures:

1. Maximum 104 degrees F dry bulb, 85 degrees F wet bulb.

2. Minimum 0 degrees F dry bulb.

d. Design Wind Velocity: 110 mph.

e. Atmospheric Conditions: Moist, dust-laden.

f. Seismic Zone: Zone 1 as defined by ICBO UBC.

1.8 MAINTENANCE

1.8.1 Extra Materials

1.8.1.1 Paint

Furnish one gallon of identical paint used on engine-generator set in manufacturer's sealed container with each engine-generator set.

1.8.1.2 Filters

Furnish four spare replacement elements in their original containers for each filter with each unit.

1.8.2 Posted Operating Instructions

Provide proposed operating instructions for the engine-generator set and auxiliary equipment laminated between matte-surface thermoplastic sheets and suitable for placement adjacent to corresponding equipment. After approval, install operating instructions where directed.

PART 2 PRODUCTS

2.1 DIESEL ENGINE-GENERATOR SET

Provide diesel engine-generator sets consisting of a water cooled diesel engine direct connected to an ac generator with a brushless excitation system and accessories. Equipment and materials shall be the manufacturer's standard products offered in catalogs for commercial or industrial use.

2.1.1 Engine-Generator Set Ratings and Performance

ISO 8528. Each engine-generator set shall have a power rating as indicated kW at 0.8 power factor and supply 60-Hz ac output. Coordinate the engine-generator set to ensure an installed rating in the environment described in paragraph entitled "Site Conditions." The power of the engine-generator set is defined as the power output available at the generator terminals excluding the electrical power absorbed by the essential independent auxiliaries. Essential independent auxiliaries are items of equipment which are essential for the continued or repeated operation of the engine which uses power supplied from a source other than the engine.

2.1.1.1 Diesel Engine Capacity

The diesel engine shall meet the specified maximum BMEP requirements at rated speed as calculated in accordance with the paragraph entitled "Calculations for BMEP." The engine capacity shall be based on the following:

a. Engine burning diesel fuel conforming to FS A-A-52557, Grade DF-2, MIL-PRF-16884, ASTM D 975, Grade 2-D, or MIL-DTL-5624, Grade JP-5 at an ambient temperature of 85 degrees F.

b. Engine cooled by a radiator fan mechanically driven by the diesel engine or remote with a motor driven fan.

c. Engine cooled by coolant mixture of water and ethylene glycol, 50

percent by volume of each.

Maximum BMEP, psi

	Naturally Aspirated	Turbocharged	Turbocharged and Intercooled
Four-cycle engines	____	____	____

Engine speed, rpm: 1800

2.1.1.2 Performance Class

The voltage and frequency behavior of the generator set shall be in accordance with ISO 8528 operating limit values for performance Class G1, G2, G3, G4 as follows.

2.1.1.3 Load Profile

The diesel engine-generator set shall be of adequate capacity necessary for the load indicated.

2.1.2 Diesel Engines and Accessories

ISO 3046. Diesel engines shall be four-cycle naturally aspirated, or turbocharged, or turbocharged and intercooled; vertical in-line or vertical Vee type; designed for stationary service. Engines shall be capable of immediate acceleration from rest to normal speed without intermediate idle/warm up period or prelubrication to provide essential electrical power. Two-cycle engines are not acceptable.

2.1.2.1 Subbase Mounting

Mount each engine-generator set on a structural steel subbase sized to support the engine, generator, and necessary accessories, auxiliaries and control equipment to produce a complete self-contained unit as standard with the manufacturer. Design the structural subbase to properly support the equipment and maintain proper alignment of the engine-generator set in the specified seismic zone. In addition, provide subbase with both lifting rings and jacking pads properly located to facilitate shipping and installation of the unit. Factory align engine and generator on the subbase and securely bolt into place in accordance with the manufacturer's standard practice. Crankshaft shall have rigid coupling for connection to the generator.

2.1.2.2 Assembly

Completely shop assemble each engine-generator set on its structural steel subbase. Paint entire unit with manufacturer's standard paints and colors. After factory tests and before shipping, thoroughly clean and retouch painting as necessary to provide complete protection.

2.1.2.3 Turbocharger

If required by the manufacturer to meet the engine-generator set rating, provide turbine type driven by exhaust gas from engine cylinders, and direct connected to the blower supplying air to the engine intake manifold.

2.1.2.4 Intercooler

Provide manufacturer's standard intercooler for engine size specified.

2.1.2.5 Crankcase Protection

Provide manufacturer's standard method of preventing crankcase explosions and standard method of crankcase ventilation. Provide ventilation of crankcase via piping to the atmosphere as indicated on the drawings.

2.1.2.6 Engine Lubricating Oil System

Provide each engine with the manufacturer's standard full pressure lubricating oil system arranged to cool the pistons and to distribute oil to moving parts of the engine. Provide oil type and oil filters as recommended by the engine manufacturer.

2.1.2.7 Engine Cooling System

Provide each engine with the manufacturer's standard jacket water pump. Provide a thermostatic control valve in the jacket coolant system for each engine-generator set to maintain a constant jacket coolant temperature to the engine.

2.1.2.8 Engine Fuel System

Provide each engine with the manufacturer's standard fuel system integral with the engine, complete with necessary piping, fittings, and valves for connecting items of equipment which are a part of the system. Provide engine manufacturer's standard hand priming pump. Provide manufacturer's standard duplex filter for each engine, of the throwaway filter element type, consisting of shell filter elements, drains, and necessary connections and fittings.

2.1.2.9 Engine Intake Filter

Provide intake filter assemblies for each engine of the oil bath or dry type, as standard with the manufacturer. Filters shall be capable of removing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filters to suit engine requirements at 100 percent of rated full load. Design unit for field access for maintenance purposes.

2.1.2.10 Engine Starting System

Starting shall be accomplished using an adequately sized dc starter system with a positive shift solenoid to engage the starter motor and to crank the engine continuously for 60 seconds without overheating.

2.1.2.11 Jacket Coolant Heating System

Provide a factory-installed, 120 volts ac, jacket coolant heating system to ensure rapid starting. Thermostatically control heater at the temperature recommended by engine manufacturer. Include necessary equipment, piping, controls, wiring, and accessories.

2.1.2.12 Engine Protective (Shutdown) Devices

Equip each engine with devices to shut down the engine by shutting off the fuel supply to the engine via a fuel shutoff solenoid. Auxiliary contacts

shall be suitable for activating a remote alarm system. Shutdown shall open the associated generator circuit breaker. Provide the following shutdown devices:

a. Overspeed device which operates when engine speed exceeds normal synchronous speed by 18 percent or as recommended by manufacturer. Device shall require manual reset.

b. Pressure switch which operates when lubricating oil pressure to engine drops below a preset value.

c. Temperature switch which operates when jacket coolant temperature exceeds a preset value.

d. Device which operates when the coolant level in the radiator drops below a preset level.

e. Other shutdown devices as recommended by the engine manufacturer.

2.1.2.13 Engine Alarm Devices

Equip each engine with alarm devices. Auxiliary contacts shall be suitable for activating a remote alarm system. Alarm devices shall have factory-fixed set points. Provide the following alarm contact devices:

a. Pressure switch which operates when lubricating oil pressure drops below a preset value.

b. Temperature switch which operates when jacket coolant temperature exceeds a preset value.

c. Temperature switch which operates when jacket coolant temperature is too low.

d. Other alarm devices as recommended by the engine manufacturer.

2.1.2.14 Miscellaneous Engine Accessories

Provide the following engine accessories where the manufacturer's standard design permits:

a. Piping on engine to inlet and outlet connections, including nonstandard companion flanges.

b. Structural steel subbase and vibration isolators, foundation bolts, nuts, and pipe sleeves.

c. Level jack screws or shims, as required.

d. Rails, chocks, and shims for installation of subbase on the foundation.

e. Removable guard, around fan. Support guard, on engine subbase, to suit manufacturer's standard.

2.1.2.15 Engine Speed Governor System

Provide a forward acting type engine speed governor system. Steady-state frequency band and frequency regulation (droop) shall be in accordance with the operating limit values of the performance class specified in the

paragraph entitled "Performance Class."

2.1.3 Generator and Excitation System

2.1.3.1 Generator

Provide salient-pole type, ac, brushless-excited, revolving field, air-cooled, self-ventilated, dripproof guarded, coupled type, synchronous generator conforming to NEMA MG 1, Part 16, 22, NEMA C50.10, and NEMA C50.12. Generator shall be rated for standby duty at 100 percent of the power rating of the engine-generator set as specified in paragraph entitled "Engine-Generator Set Ratings and Performance." Temperature rise of each of the various parts of the generator shall not exceed 130, 105 degrees C as measured by resistance, based on a maximum ambient temperature of 40 degrees C. Winding insulation shall be Class H.

a. Stator: Stator windings shall be 2/3 pitch design, 10-12 lead reconnectable with VPI insulated coils.

b. Rotor: The rotor shall have connected amortisser windings.

c. Generator Space Heater: Provide 120 volt ac heaters. Heater capacity shall be as recommended by the generator manufacturer to aid in keeping the generator insulation dry.

d. Grounding: Provide non-corrosive steel grounding pads located at two opposite mounting legs.

e. Filters: Provide manufacturer's standard generator cooling air filter assembly.

2.1.3.2 Excitation System

Provide a brushless excitation system consisting of an exciter and rotating rectifier assembly integral with the generator and a voltage regulator. Insulation class for parts integral with the generator shall be as specified in paragraph entitled "Generator." System shall provide a minimum short circuit of 300 percent rated engine-generator set current for at least 10 seconds. Steady state voltage regulation shall be in accordance with the operating limit values of the performance class specified in the paragraph entitled "Performance Class."

a. Exciter and Rotating Rectifier Assembly: Rectifiers shall be provided with surge voltage protection.

b. Voltage Regulator: Voltage regulator shall be solid state or digital, automatic, three-phase sensing, volts per hertz type regulator. Regulator shall receive its input power from a PMG. Voltage variation for any 40 degree C change over the operating temperature range shall be less than plus or minus 1.0 percent. Operating temperature shall be minus 40 degree C to plus 70 degree C. Voltage adjust range shall be plus to minus 5.0 percent of nominal. Inherent regulator features shall include overexcitation shutdown.

2.1.3.3 Electromagnetic Interference (EMI) Suppression

Provide as an integral part of the generator and excitation system, EMI suppression complying with MIL-STD-461.

2.2 ENGINE-GENERATOR SET AUXILIARY SYSTEMS AND EQUIPMENT

Provide auxiliary systems and equipment designed for continuous duty at 100 percent of the power rating of the engine-generator set as specified in the paragraph entitled "Engine-Generator Set Ratings and Performance."

2.2.1 Vibration Isolation System

Install the subbase on vibration isolators that are secured to a suitable concrete foundation. Provide isolators as recommended by the engine-generator set and isolator manufacturers and provide integral or external lateral support to limit lateral movement and overturning moments. The isolation system shall reduce the vibration transmitted to the adjacent floor slab to a maximum of 0.0015 inch total amplitude throughout the frequency range down to 65 Hz.

2.2.2 Exhaust System

Provide exhaust systems for each engine.

2.2.2.1 Exhaust Silencers

A residential class silencer shall be provided for each engine which will reduce the exhaust sound spectrum by the following listed values at a 75 foot radius from the outlet, with generator set loaded to rated capacity and clear weather. Inlet and outlet connections shall be flanged.

	Octave Band Center Frequency (Hertz)							
Minimum Silencer Attenuation Decibels	63	125	250	500	1000	2000	4000	8000
Residential Class	10	25	32	30	25	25	24	23
Critical Class	15	32	37	36	30	36	37	37

2.2.2.2 Field Installed Exhaust Piping System

Field installed exhaust piping shall conform to the following:

a. Exhaust Piping: Provide flanges for connections to diesel engines, exhaust mufflers, and flexible connections. Provide steel pipe conforming to ASTM A 53/A 53M for each engine complete with necessary fittings, flanges, gaskets, bolts, and nuts. Exhaust piping shall be Schedule 40 pipe for 12 inches and smaller, standard weight for sizes 14 inches through 24 inches, and 0.25 inch wall thickness for sizes larger than 24 inches. Flanges shall be Class 150 slip-on forged steel welding flanges in accordance with ASME B16.5, with material in accordance with ASTM A 181/A 181M, Grade I. Fittings shall be buttwelding conforming to ASTM A 234/A 234M, with wall thickness same as adjoining piping. Fittings shall be of same material and wall thickness as pipe. Built-up miter welded fittings may be used. Miter angles of each individual section shall not exceed 22.5 degrees total and not more than 11.25 degrees relative to the axis of the pipe at any one cut. Gaskets for exhaust piping shall be of high temperature

asbestos-free material suitable for the service and shall be ASME B16.21, composition ring, 0.0625 inch thick. Bolting material for exhaust flanges shall be alloy-steel bolt-studs conforming to ASTM A 193/A 193M, Grade B7 bolts and alloy-steel nuts conforming to ASTM A 194/A 194M, Grade 7. Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project not more than two full threads beyond the nut. Provide stainless steel counterbalance type rain caps at termination of each exhaust pipe.

b. Expansion (Flexible) Joints: Provide sections of multiple corrugated stainless steel expansion joints with liners in the engine exhaust piping for each engine to absorb expansion strains and vibration transmitted to the piping. Flexible joints shall be suitable for operation at 200 degrees F above normal exhaust gas temperature at 100 percent load, 10,000 cycles, minimum. Joints shall be flanged and located between engine exhaust manifold and exhaust piping, shall be the same size as exhaust piping size, and shall be designed and constructed for diesel engine exhaust service.

c. Hangers and Supports: MSS SP-58 and MSS SP-69.

d. Piping Sleeves: Provide where piping passes through masonry or concrete walls, floors, roofs, and partitions. Sleeves shall be placed during construction. Unless indicated otherwise, pipe sleeves shall comply with following requirements: sleeves in outside walls below and above grade, in floor, or in roof slabs, shall be standard weight zinc coated steel pipe. Sleeves in partitions shall be zinc coated sheet steel having a nominal weight of not less than 0.90 pound per square foot. Space between piping insulation and the sleeve shall not be less than 0.25 inch. Sleeves shall be held securely in proper position and location during construction. Sleeves shall be sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Space between the pipe and the sleeve shall be firmly packed with insulation and calked at both ends of the sleeve with plastic waterproof cement.

e. Piping Insulation: Provide exhaust piping insulation in accordance with Section 23 07 00,"Insulation of Mechanical Systems."

2.2.3 Cooling System

Provide the specified cooling water system. Properly size equipment to handle the flow rate and pressure losses of the coolant mixture specified in the paragraph entitled "Diesel Engine Capacity," and at the site elevation specified in the paragraph entitled "Site Conditions."

2.2.3.1 Radiators

Provide for each engine-generator set, as standard with the manufacturer.

a. Design Conditions: Each radiator unit shall have ample capacity to remove not less than the total Btu per hour of heat rejected by its respective engine at 100 percent full-rated load to the jacket water, fuel oil, and lubricating oil system, and intercooler. Radiator capacity shall be rated at optimum temperature of coolant leaving the engine and intercooler as recommended by the engine manufacturer with an ambient dry bulb air temperature outside the enclosure as indicated, and _____ degrees F minimum at the site elevation specified in the paragraph entitled "Site Conditions," and with the coolant mixture

specified in the paragraph entitled "Diesel Engine Capacity." Pressure drop through the radiator shall not exceed 6 psi when circulating the maximum required coolant flow. Radiator air velocity shall be a maximum of 1500 feet per minute.

b. Engine Mounted Radiator Construction: Radiator fan shall direct airflow from the engine outward through the radiator. Fan shall be V-belt driven directly from the engine crankshaft. Radiator fan shall have sufficient capacity to meet design conditions against a static restriction as indicated. Fan static capacity shall be adjusted to suit the ductwork furnished. Cooling section shall have a tube and fin-type core consisting of copper or copper base alloy tubes with nonferrous fins. Select engine-driven fans for quiet vibration-free operation. Make provision for coolant expansion either by self-contained expansion tanks or separately mounted expansion tanks, as standard with the manufacturer. Provide suitable guards for each fan and drive.

c. Coolant solution shall be a mixture of clean water and ethylene glycol, 50 percent by volume each. Provide an anti-freeze solution tester suitable for the mixture.

2.2.3.2 Jacket Coolant Water Piping Systems

Field installed jacket coolant water piping shall conform to the following:

a. Piping: Provide seamless steel pipe, Schedule 40, conforming to ASTM A 53/A 53M, Grade A.

b. Fittings and Flanges: Fittings, 1 1/2 inches or smaller, shall be malleable iron conforming to ASME B16.3 for Class 300 threaded type. Fittings, 2 inches and larger, shall be steel buttwelding conforming to ASME B16.9. Utilize either ASME B16.1 or Class A of ASTM A 126 for Class 125 cast-iron flanged fittings. Flanges shall be Class 150 slip-on forged steel welding flanges in accordance with ASME B16.5, with material in accordance with ASTM A 181/A 181M, Grade I. Provide flat face flanges for connecting to Class 125 standard cast-iron valves, fittings, and equipment connections.

c. Valves

1. Gate Valves: For valves, 1 1/2 inches and smaller, provide double disk, rising stem, inside screw, union bonnet type, Class 125 bronze material conforming to MSS SP-80. For valves, 2 inches and larger, provide double-disk, parallel seat type, hydraulic-rated, Class 125, outside screw and yoke type with flanged ends and bronze trim conforming to MSS SP-70. Provide stem packing of material compatible with the system coolant.

2. Globe Valves: For valves, 1 1/2 inches and smaller, provide rising stem, inside screw, union bonnet type, Class 125 bronze valves conforming to MSS SP-80. For valves, 2 inches and larger, provide Class 125 cast iron, flanged ends, bronze trim globe valves conforming to MSS SP-85. Valves shall have renewable composition or cast iron discs compatible with the system coolant.

3. Check Valves: MSS SP-71 or MSS SP-80, swing check type.

d. Hangers and Supports: MSS SP-58 and MSS SP-69.

e. Piping Sleeves: Provide where piping passes through masonry or concrete walls, floors, roofs, and partitions. Place sleeves during construction. Unless indicated otherwise, pipe sleeves shall comply with following requirements: Sleeves in outside walls below and above grade, in floor, or in roof slabs, shall be standard weight zinc coated steel pipe. Sleeves in partitions shall be zinc coated sheet steel having a nominal weight of not less than 0.90 pound per square foot. Space between piping insulation and the sleeve shall be not less than 0.25 inch. Sleeves shall be held securely in proper position and location during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Space between the pipe and the sleeve shall be firmly packed with insulation and calked at both ends of the sleeve with plastic waterproof cement.

2.2.4 Diesel Fuel System

NFPA 30 and NFPA 37 and the requirements herein.

2.2.4.1 Diesel Fuel Piping System

Factory installed piping shall conform to the engine manufacturer's standard. Provide flange connections in accordance with ASME B16.1 Class 125 flanges. Piping between the engine and the diesel fuel day tank shall comply with Section 23 11 13.00 20, "Fuel Oil Piping."

2.2.4.2 Diesel Fuel Day Tank System

Provide 120 volt ac diesel fuel day tank system. Include necessary equipment, piping, controls, wiring, and accessories.

a. Day Tanks: UL 142. Provide free standing double wall (110 percent containment) diesel fuel day tanks with a minimum capacity of 8 hours of engine-generator set operation at full-rated load capacity as indicated. Epoxy coat day tanks inside and prime and paint outside. Construct tanks of not less than 3/16 inch steel plate with welded joints and necessary stiffeners on exterior of tank. Provide a braced structural steel framework support. Weld tank top tight and provide an access opening with dustproof, removable 24 inch cover. Provide 4 1/2 inch square inspection port. Provide proper venting of both inner and outer containment.

b. Float Switches: Provide tank-top mounted or external float cage, single-pole, single-throw type designed for use on fuel oil tanks. Arrange high level float switches to close on rise of liquid level, and low level float switches to close on fall of liquid level. Mount float cage units with isolating and drain valves. Contacts shall be suitable for the station battery voltage.

1. Critical low level float switch which shall activate at 5 percent of normal liquid level shall shut engine off.

2. Low-low level float switch which shall activate alarm at 30 percent of normal liquid level.

3. Low level float switch which shall open the fuel oil solenoid valve and start the remote fuel transfer pump at 75 percent of normal liquid level.

4. High level float switch which shall close the fuel oil solenoid valve and stop the remote fuel transfer pump at 90 percent of normal liquid level.

5. Critical high level float switch which shall activate alarm at 95 percent of normal liquid level.

c. Leak Detector Switch: Actuates when fuel is detected in containment basin, stops fuel transfer pump, and closes the fuel oil solenoid valve.

d. Control Panel: Provide NEMA ICS 6, Type 1, enclosed control panel for each day tank. Control panel shall include the following accessories.

1. Power available LED (green).

2. Critical low fuel alarm contacts for shut down of engine.

3. Low-low level fuel alarm LED.

4. Low-low level fuel alarm contacts for remote annunciator.

5. Critical high level fuel alarm LED.

6. Leak detecting alarm LED.

7. Alarm horn.

e. Tank Gages: Provide buoyant force type gages for diesel fuel day tanks with dial indicator not less than 4 inches in size and arranged for top mounting. Calibrate each reading dial or scale for its specific tank to read from empty to full, with intermediate points of 1/4, 1/2, and 3/4.

2.2.4.3 Fuel Transfer Pumps

Fuel transfer pumps may be day tank or base mounted. Pumps shall be duplex, horizontal, positive displacement. Direct-connect pump to motor through a flexible coupling. Equip each pump with a bypass relief valve, if not provided with an internal relief valve. Provide motor and controller in accordance with paragraph entitled "Electrical Support Equipment."

2.2.4.4 Fuel Oil Solenoid Valve

UL 429. Provide electric solenoid type control valve for each day tank. Solenoid shall be rated for starting battery voltage. Valve body shall have a minimum working pressure rating of 150psig at 200 degrees F. Valve shall be capable of passing 0 to 10 gpm of fuel oil. Valves shall be two-way, direct acting, normally closed (open when energized, closed when de-energized), with brass body and resilient seat material. Solenoid enclosures shall be NEMA ICS 6, Type 1. Body connections shall be same size as connecting piping. Valve shall be in line before the fuel pump.

2.2.4.5 Strainer

Duplex strainers shall comply with Section 23 11 13.00 20, "Fuel Oil Piping."

2.2.4.6 Fuel Oil Meters

Fuel oil meter shall comply with Section 23 11 13.00 20, "Fuel Oil Piping."

2.2.4.7 Fuel Oil Cooler

Provide an air cooled fuel oil cooler if the temperature of the fuel returned to the tank from the engine will cause overheating of the tank fuel above the maximum fuel temperature allowed by the engine manufacturer when operating at maximum rated generator power output and low fuel level in the tank. The fuel oil cooler shall be furnished by the engine manufacturer for the application and the installation shall be complete including piping and power requirements.

2.2.5 Starting Battery System

Provide a 12-volt dc starting battery installation for starting of each engine-generator set utilizing an electric cranking system.

2.2.5.1 Engine Starting Battery

Provide maintenance free, sealed, lead-acid, SAE Type D diesel engine starting batteries. Battery configuration shall be two parallel sets of two 12-volt batteries. Batteries shall have sufficient capacity to provide 60 seconds of continuous cranking of the engine in an ambient temperature of _____ degrees F.

2.2.5.2 Starting Battery Charger

UL 1236. Provide 120 volt ac, enclosed, automatic equalizing, dual-rate, solid-state, constant voltage type battery charger with automatic ac line compensation. Dc output shall be voltage regulated and current limited. Charger shall have two ranges, float and equalize, and shall provide continuous taper charging. The charger shall have a continuous output rating of not less than 10 amperes and shall be sized to recharge the engine starting batteries in a minimum of 8 hours while providing the control power needs of the engine-generator set. Enclosure shall be NEMA ICS 6, Type 1. The following accessories shall be included:

a. Dc ammeter

b. Dc voltmeter

c. Equalize light

d. Ac on light

e. Low voltage light

f. High voltage light

g. Equalize test button/switch

h. Ac circuit breaker

i. Low dc voltage alarm relay

j. High dc voltage alarm relay

k. Current failure relay

l. Ac power failure relay

2.2.6 Engine-Generator Control Panel

Provide NEMA ICS 6, Type 1, enclosed control panel mounted on the engine-generator set with vibration isolators. Provide the following control panel mounted devices and control features.

2.2.6.1 Control Panel Mounted Devices

a. Engine Control Switch (ECS): Provide a three position control switch with "MANUAL START" - "OFF/RESET" - "AUTO START" positions.

b. Emergency Stop Push Button (ESPB): Provide a red, mushroom head, twist-to-reset, maintained contact type push button.

c. Generator Metering: Provide ac metering package that displays ac voltage, current, and frequency of one phase of the generator output simultaneously. Metering package shall include a voltmeter/ammeter phase selector switch to allow viewing of each phase.

d. Generator Voltage Adjust Potentiometer (VAP): Provide a potentiometer, locking screwdriver type, to adjust generator voltage.

e. Engine Instrumentation: Provide instrumentation package that displays the following engine information:

1. Engine oil pressure

2. Engine coolant temperature

3. Engine speed (rpm)

4. Engine running hours

f. Indicating Lamps: Provide LED type indicating lamps and a lamp test switch. Lamps shall indicate the following alarm and shutdown conditions:

1. Low engine lubricating oil pressure alarm

2. Low engine lubricating oil pressure shutdown

3. High engine coolant temperature alarm

4. High engine coolant temperature shutdown

5. Engine overcrank shutdown

6. Engine overspeed shutdown

7. Emergency stop shutdown

8. Starting battery system trouble alarm

9. Day tank low fuel shutdown

10. Low engine coolant temperature alarm

11. Low coolant level shutdown

g. Alarm Horn: Provide an alarm horn and a horn silence switch.

h. Panel Lamp: Provide a panel lamp and lamp "ON-OFF" switch.

2.2.6.2 Crank Cycle/Terminate Relay

Provide crank cycle/terminate relay with adjustable crank/rest periods of 1 to 60 seconds (initially set for 15 seconds) and adjustable total crank time of 30 seconds to 10 minutes (initially set for 75 seconds).

2.2.6.3 Engine Cooldown Relay

Provide cooldown relay with adjustable cool down time of 0 to 30 minutes (initially set at engine manufacturer's recommended time).

2.2.7 Remote Alarm Annunciator

Provide NEMA ICS 6, Type 1, enclosed remote alarm annunciator powered by the engine starting battery system. The annunciator shall have a lamp test switch and LED type indicating lamps. The annunciator shall give visual and audible warnings for the following operating and alarm conditions:

a. Provide lamps for the following operating conditions:

1. Operating power source, normal or emergency

2. Starting battery system trouble

b. Provide lamps and an audible signal for the following alarm conditions:

1. Low engine lubricating oil pressure

2. Low engine coolant temperature

3. High engine coolant temperature

4. Low fuel

5. Engine overcrank shutdown

6. Engine overspeed shutdown

2.2.7.1 Storage Battery

Provide storage batteries of suitable rating and capacity to supply and maintain power for the remote alarm annunciator for a period of 90 minutes minimum without the voltage applied falling below 87.5 percent of normal. Provide a 120 volt ac automatic battery charger.

2.2.8 Generator Circuit Breaker

UL 489, molded case, adjustable thermal magnetic trip type circuit breaker. The circuit breaker continuous current rating shall be adequate for the power rating of the engine-generator set and the circuit breaker shall be rated to withstand the short circuit current provided by the generator set.

Provide circuit breaker in a NEMA ICS 6, Type 1 enclosure mounted on the engine-generator set.

2.2.9 Electrical Support Equipment

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to Section 26 20 00, "Interior Distribution System." Provide electrical connections under Section 26 20 00, "Interior Distribution System." Provide controllers and contactors with maximum of 120-volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than size indicated, the cost of providing additional electrical service and related work shall be included under this section.

2.2.10 Weatherproof Enclosure

Provide for each engine-generator set and fabricate from zinc coated or phosphatized and shop primed 16 gage minimum sheet steel in accordance with the manufacturer's standard design. Provide a complete, weatherproof enclosure for the engine, generator, and auxiliary systems and equipment. Support exhaust piping and silencer so that the turbocharger is not subjected to exhaust system weight or lateral forces generated in connecting piping that exceed the engine manufacturer's maximum allowed forces and moments. The housing shall have sufficient louvered openings to allow entrance of outside air for engine and generator cooling at full load. Design louvered openings to exclude driving rain and snow. Provide properly arranged and sized, hinged panels in the enclosure to allow convenient access to the engine, generator, and control equipment for maintenance and operational procedures. Provide hinged panels with spring type latches which shall hold the panels closed securely and will not allow them to vibrate. Brace the housing internally to prevent excessive vibration when the set is in operation.

2.3 SPECIAL WRENCHES AND TOOLS

Wrenches and tools specifically designed and required to work on the new equipment, which are not commercially available as standard mechanic's tools, shall be furnished to the Contracting Officer.

2.4 IDENTIFICATION OF EQUIPMENT

Provide plates and tags sized so that inscription is readily legible to operating or maintenance personnel and securely mounted to or attached in proximity of their identified controls or equipment. Lettering shall be normal block lettering, a minimum of 0.25 inch high.

2.4.1 Materials

Construct ID plates and tags of 16 gage minimum thickness bronze or stainless steel sheet metal engraved or stamped with inscription. Construct plates and tags not exposed to the weather or high operational temperature of the diesel engine of laminated plastic, 0.125 inch thick, matte white finish with black center core, with lettering accurately aligned and engraved into the core.

2.4.2 Control Devices and Operation Indicators

Provide ID plates or tags for control devices and operation indicators, including valves, off-on switches, visual alarm annunciators, gages and

thermometers, that are required for operation and maintenance of provided mechanical systems. Plates or tags shall be minimum of 0.5 inch high and 2 inches long and shall indicate component system and component function.

2.4.3 Equipment

Provide ID plates of a minimum size of 3 inches high and 5 inches long on provided equipment indicating the following information:

a. Manufacturer's name, address, type and model number, and serial number;

b. Contract number and accepted date;

c. Capacity or size;

d. System in which installed; and

e. System which it controls.

2.5 ASSEMBLED OPERATION AND MAINTENANCE MANUALS

The contents of the assembled operation and maintenance manuals shall include the manufacturer's O&M information required by the paragraph entitled "SD-10, Operation and Maintenance Data" and the manufacturer's O&M information specified in Section 26 36 23.00 20, "Automatic Transfer and Bypass/Isolation Switches."

a. Manuals shall be in separate books or volumes, assembled and bound securely in durable, hard covered, water resistant binder, and indexed by major assembly and components in sequential order.

b. A table of contents (index) shall be made part of the assembled O&M. The manual shall be assembled in the order noted in table of contents.

c. The cover sheet or binder on each volume of the manuals shall be identified and marked with the words, "Operation and Maintenance Manual."

2.6 SOURCE QUALITY CONTROL

Perform and report on factory tests and inspections prior to shipment. Provide certified copies of manufacturer's test data and results. Test procedures shall conform to ASME, IEEE, IEC, and ANSI standards, and to ISO requirements on testing, as appropriate and applicable. The manufacturer performing the tests shall provide equipment, labor, and consumables necessary for tests and measuring and indicating devices shall be certified to be within calibration. Tests shall indicate satisfactory operation and attainment of specified performance. If satisfactory, equipment tested will be given a tentative approval. Equipment shall not be shipped before approval of the factory test reports for the following tests.

2.6.1 Engine Tests

Perform customary commercial factory tests in accordance with ISO 3046 on each engine and associated engine protective device, including, but not limited to the following:

a. Perform dynamometer test at rated power. Record horsepower at rated speed and nominal characteristics such as lubricating oil pressure,

jacket water temperature, and ambient temperature.

b. Test and record the values that the low oil pressure alarm and protective shutdown devices actuate prior to assembly on the engine.

c. Test and record values that the high jacket water temperature alarm and protective shutdown devices actuate prior to assembly on the engine.

2.6.2 Generator Tests

Tests shall be performed on the complete factory assembled generator prior to shipment. Conduct tests in accordance with IEEE Std 115, NEMA C50.10, IEC 60034-2, and NEMA MG 1.

2.6.2.1 Routine Tests

Perform the following routine tests on the generators and their exciters:

a. Resistance of armature and field windings

b. Mechanical balance

c. Phases sequence

d. Open circuit saturation curve and phase (voltage) balance test

e. Insulation resistance of armature and field windings

f. High potential test

2.6.2.2 Design Tests

Submit the following design tests made on prototype machines that are physically and electrically identical to the generators specified.

a. Temperature rise test

b. Short circuit saturation curve and current balance test

2.6.3 Assembled Engine-Generator Set Tests

2.6.3.1 Initial Stabilization Readings

Operate the engine-generator set and allow the set to stabilize at rated kW at rated power factor, rated voltage, and rated frequency. During this period record instrument readings for output power (kW), terminal voltage, line current, power factor, frequency (rpm) generator (exciter) field voltage and current, lubricating oil pressure, jacket water temperature, and ambient temperature at minimum intervals of 15 minutes. Adjust the load, voltage, and frequency to maintain rated load at rated voltage and frequency. Adjustments to load, voltage, or frequency controls shall be recorded on the data sheet at the time of adjustment. Stabilization shall be considered to have occurred when four consecutive voltage and current recorded readings of the generator (or exciter) field either remain unchanged or have only minor variations about an equilibrium condition with no evident continued increase or decrease in value after the last adjustment to the load, voltage, or frequency has been made.

2.6.3.2 Regulator Range Test

Remove load and record instrument readings (after transients have subsided). Adjust voltage to the maximum attainable value or to a value just prior to actuation of the overvoltage protection device. Apply rated load and adjust voltage to the minimum attainable value or a value just prior to activation of the undervoltage protection device. The data sheets shall indicate the voltage regulation as a percent of rated voltage and the maximum and minimum voltages attainable. Voltage regulation shall be defined as follows:

$$\text{Percent Regulation} = \frac{((\text{No-Load Voltage}) - (\text{Rated-Load Voltage})) \times 100}{(\text{Rated-Load Voltage})}$$

2.6.3.3 Frequency Range Test

Adjust the engine-generator set frequency for the maximum attainable frequency at rated load. Record instrument readings. Adjust the engine-generator set frequency for the specified minimum attainable frequency at rated load. Record instrument readings. Reduce the load to zero and adjust the engine-generator set frequency for the maximum attainable frequency. Record instrument readings. Adjust the engine-generator set frequency for the minimum attainable frequency. Record instrument readings. The data sheet shall show the maximum and minimum frequencies attained at rated load, and at no load.

2.6.3.4 Transient Response Test

Drop the load to no load and re-apply rated load three times to ensure that the no load and rated load voltage and frequency values are repeatable and that the frequency and voltage regulation is within the limits specified. Record generator terminal voltage and frequency using a high speed strip chart recorder. The data sheet shall show the following results:

a. Frequency

    1. Stability bandwidth or deviation in percent of rated frequency.

    2. Recovery time.

    3. Overshoot and undershoot.

b. Voltage

    1. Stability bandwidth or deviation in percent of rated voltage.

    2. Recovery time.

    3. Overshoot and undershoot.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the applicable requirements of IEEE C2 NFPA 30, NFPA 37, and NFPA 70.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02, "Underground Transmission and Distribution" and Section 33 71 01, "Overhead Transmission and Distribution". Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Engine-Generator Set Grounding

Provide separate copper grounding conductors and connect them to the ground system as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Connections

Make joints in grounding conductors by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in Section 33 71 02, "Underground Transmission and Distribution," paragraph entitled "Grounding."

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 START-UP ENGINEER

Provide the services of a qualified factory trained start-up engineer, regularly employed by the engine-generator set manufacturer. The start-up services shall include conducting preliminary operations and functional acceptance tests. The start-up engineer shall be present at the engine generator set installation site, full-time, while preliminary operations and functional acceptance tests are being conducted.

3.4 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the engine-generator set and auxiliary equipment.

3.4.1 Piping Tests

Complete as specified in Section 23 11 13.00 20, "Fuel Oil Piping."

3.4.2 Performance of Acceptance Checks and Tests

The acceptance checks and tests shall be accomplished by the testing organization as described in Section 26 08 00, "Apparatus Inspection and Testing."

3.4.2.1 Generator Sets

Complete as specified in the paragraph entitled "Acceptance Checks and

Tests."

3.4.2.2 Automatic Transfer Switches

Complete acceptance checks and tests as specified in Section 26 36 23.00 20, Automatic Transfer and Bypass/Isolation Switches."

3.4.3 Preliminary Operations

The start-up engineer shall conduct manufacturer recommended start-up procedures and tests to verify that the engine-generator set and auxiliary equipment are ready for functional acceptance tests. Give the Contracting Officer 15 days' advance notice that preliminary operations will be conducted. After preliminary operation has been successfully conducted, the start-up engineer will notify the Contracting Officer in writing stating the engine-generator set and auxiliary equipment are ready for functional acceptance tests.

3.4.4 Preliminary Assembled Operation and Maintenance Manuals

Preliminary assembled operation and maintenance manuals shall have been submitted to and approved by the Contracting Officer. Manuals shall be prepared as specified in the paragraph entitled "Assembled Operation and Maintenance Manuals."

3.4.5 Functional Acceptance Test Procedure

Test procedure shall be prepared by the start-up engineer specifically for the engine-generator set and auxiliary equipment. The test agenda shall cover the requirements specified in the paragraph entitled "Functional Acceptance Tests." The test procedure shall indicate in detail how tests are to be conducted. A statement of the tests that are to be performed without indicating how the tests are to be performed is not acceptable. Indicate what work is planned on each workday and identify the calendar dates of the planned workdays. Specify what additional technical support personnel is needed such as factory representatives for major equipment. Specify on which testing workday each technical support personnel is needed. Data recording forms to be used to document test results are to be submitted with the proposed test procedure. A list of test equipment and instruments shall also be included in the test procedure.

3.4.6 Test Equipment

Test equipment and instruments shall be on hand prior to scheduling field tests or, subject to Contracting Officer approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

3.5 FIELD QUALITY CONTROL

Give Contracting Officer and LANTNAVFACENGCOM CI52 (757-322-8420) 15 days notice of dates and times scheduled for tests which require the presence of the Contracting Officer. The Contracting Officer will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The Contractor shall be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The Contractor shall provide labor, equipment, diesel fuel, test load, and consumables required

for the specified tests. The test load shall be a cataloged product. Calibration of measuring devices and indicating devices shall be certified. Refer to Section 26 00 00, "Basic Electrical Materials and Methods," for requirements for a cataloged product. Perform the following field tests.

3.5.1 Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.1.1 Circuit Breakers - Low Voltage Insulated Case/Molded Case

a. Visual and mechanical inspection

1. Compare nameplate data with specifications and approved shop drawings.

2. Inspect circuit breaker for correct mounting.

3. Operate circuit breaker to ensure smooth operation.

4. Inspect case for cracks or other defects.

5. Verify tightness of accessible bolted connections and cable connections by calibrated torque-wrench method. Thermographic survey is not required.

6. Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

1. Perform contact-resistance tests.

2. Perform insulation-resistance tests.

3. Adjust Breaker(s) for final settings in accordance with engine-generator set manufacturer's requirements.

3.5.1.2 Current Transformers

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Verify that adequate clearances exist between primary and secondary circuit.

5. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

6. Verify that all required grounding and shorting connections

provide good contact.

b. Electrical Tests

1. Perform insulation-resistance tests.

2. Perform polarity tests.

3. Perform ratio-verification tests.

3.5.1.3 Metering and Instrumentation

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of electrical connections.

b. Electrical Tests

1. Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

2. Calibrate watthour meters according to manufacturer's published data.

3. Verify all instrument multipliers.

4. Electrically confirm that current transformer secondary circuits are intact.

3.5.1.4 Battery Systems

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

4. Measure electrolyte specific gravity and temperature and visually check fill level.

5. Verify adequacy of battery support racks, mounting, anchorage, and clearances.

b. Electrical tests

1. Set charger float and equalizing voltage levels.

2. Verify all charger functions and alarms.

3. Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.

4. Perform a capacity load test.

3.5.1.5 Engine-Generator Set

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Inspect for correct anchorage and grounding.

b. Electrical and mechanical tests

1. Perform an insulation-resistance test on generator winding with respect to ground. Calculate polarization index.

2. Perform phase rotation test to determine compatibility with load requirements.

3.5.1.6 Grounding System

a. Visual and mechanical inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

1. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.5.2 Functional Acceptance Tests

The tests shall be performed by the start-up engineer. Upon successful test completion, the start-up engineer shall provide the Contracting Officer with a written test report within 15 calendar days showing the tests performed and the results of each test. The report shall include the completed approved test data forms and certification from the start-up engineer that the test results fall within the manufacturer's recommended limits and meet the specified requirements performance. The report shall be dated and signed by the start-up engineer, and submitted for approval by the Contracting Officer. The Contracting Officer will witness final acceptance tests. Testing shall include but not be limited to:

a. Verify proper functioning of each engine protective shutdown device and

pre-shutdown alarm device. Testing of the devices shall be accomplished by simulating device actuation and observing proper alarm and engine shutdown operation.

b. Verify proper functioning of the engine overspeed trip device. Testing of the overspeed trip device shall be accomplished by raising the speed of the engine-generator set until an overspeed trip is experienced.

c. Verify proper functioning of the crank cycle/terminate relay. Testing of the relay shall be accomplished by engaging the starter motor with the engine being prevented from running. Observe the complete crank/rest cycle as described in the paragraph entitled "Crank Cycle/Terminate Relay."

d. Verify proper functioning of the following automatic and manual operations. Testing shall include but not be limited to:

1. Loss of Utility: Initiate a normal power failure with connected test load of rated kW at 1.0 power factor. Record time delay on start, cranking time until engine starts and runs, time to come up to operating speed, voltage and frequency overshoot, and time to achieve steady state conditions with all switches transferred to emergency position.

2. Return of Utility: Return normal power and record time delay on retransfer for each automatic transfer switch, and time delay on engine cooldown and shutdown.

3. Manual starting

4. Emergency stop

e. Operate the engine-generator set at rated current (amperes) until the jacket water temperature stabilizes. Stabilization will be considered to have occurred when three consecutive temperature readings remain unchanged. Continue to operate the generator set for an additional 2 hours. Record instrument readings for terminal voltage, line current, frequency (Hz), engine speed rpm, lubricating oil pressure, jacket water temperature, and ambient temperature at 5 minute intervals for first 15 minutes and at 15 minute intervals thereafter.

3.6 DEMONSTRATION

Upon completion of the work and at a time approved by the Contracting Officer, the Contractor shall provide instructions by a qualified instructor to the Government personnel in the proper operation and maintenance of the equipment. Government personnel shall receive training comparable to the equipment manufacturer's factory training. The duration of instruction shall be for not less than one 8 hour working day for instruction of operating personnel and not less than one 8 hour working day for instruction of maintenance personnel.

3.6.1 Instructor's Qualification Resume

Instructors shall be regular employees of the engine-generator set manufacturer. The instruction personnel provided to satisfy the requirements above shall be factory certified by the related equipment manufacturer to provide instruction services. Submit the name and

qualification resume of instructor to the Contracting Officer for approval.

3.6.2 Training Plan

Submit training plan 30 calendar days prior to training sessions. Training plan shall include scheduling, content, outline, and training material (handouts). Content shall include but not limited to the following:

3.6.2.1 Operating Personnel Training

This instruction includes operating the engine-generator set, auxiliary equipment including automatic transfer switches in all modes, and the use of all functions and features specified.

3.6.2.2 Maintenance Personnel Training

Shall include mechanical, hydraulic, electrical, and electronic instructions for the engine-generator set and auxiliary equipment including automatic transfer switches.

a. Mechanical Training: Shall include at least the following:

1. A review of mechanical diagrams and drawings.

2. Component location and functions.

3. Troubleshooting procedures and techniques.

4. Repair procedures.

5. Assembly/disassembly procedures.

6. Adjustments (how, when, and where).

7. Preventive maintenance procedures.

8. Review of flow diagram.

9. Valve locations and function.

10. Valve and hydraulic equipment adjustment and maintenance procedures.

11. Hydraulic system maintenance and servicing.

12. Lubrication points, type, and recommended procedures and frequency.

b. Electrical and Electronic Maintenance Training: Shall include at least the following:

1. A review of electrical and electronic systems including wiring diagrams and drawings.

2. Troubleshooting procedures for the machine and control systems.

3. Electrical and electronic equipment servicing and care.

4. Use of diagnostics to locate the causes of malfunction.

5. Procedures for adjustments (locating components, adjustments to be made, values to be measured, and equipment required for making adjustments).

6. Maintenance and troubleshooting procedures for microprocessor or minicomputer where applicable.

7. Circuit board repair procedures where applicable (with schematics provided).

8. Use of diagnostic tapes.

9. Recommended maintenance servicing and repair for motors, switches, relays, solenoids, and other auxiliary equipment and devices.

-- End of Section --

SECTION 26 32 14.00 10

DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments

ASME INTERNATIONAL (ASME)

ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.3	(2006) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B31.1	(2007) Power Piping
ASME BPVC SEC IX	(2007) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2007) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 106/A 106M	(2006a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 135/A 135M	(2006) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A 181/A 181M	(2006) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A 234/A 234M	(2007) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B 395/B 395M	(2002) Standard Specification for U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
ASTM D 975	(2007b) Standard Specification for Diesel Fuel Oils

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995) Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2007) National Electrical Safety Code
IEEE Std 1	(2000) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms
IEEE Std 120	(1989; R 1997) Master Test Guide for Electrical Measurements in Power Circuits
IEEE Std 519	(1992) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures

NEMA C12.11	(1987; R 2002) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 6	(1993; R 2006) Standard for Industrial Controls and Systems Enclosures
NEMA MG 1	(2007) Standard for Motors and Generators
NEMA PB 1	(2006) Standard for Panelboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 110	(2005) Standard for Emergency and Standby Power Systems
NFPA 30	(2007) Flammable and Combustible Liquids Code
NFPA 37	(2006) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(2007) National Electrical Code - 2008 Edition
NFPA 99	(2005; Errata 2005) Health Care Facilities

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE ARP892	(1965; R 1994) DC Starter-Generator, Engine
SAE J537	(2000) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 1236	(2006) Standard for Safety Battery Chargers for Charging Engine-Starter Batteries
UL 489	(2002; Rev thru Jun 2006) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 891	(2005) Dead-Front Switchboards

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detailed Drawings

Detailed drawings, as specified.

Acceptance

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation. Layout drawings shall be revised to reflect the as-built conditions and submitted with the as-built drawings.

SD-03 Product Data

Performance Tests

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Limitations

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Generator

Each generator KW rating and short circuit capacity (both symmetric and asymmetric).

Integral Main Fuel Storage Tank
Day Tank

Calculations for the capacity of each day tank, including allowances for recirculated fuel, usable tank capacity, and duration of fuel supply.

Power Factor

Generator capability curve showing generator kVA output (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Heat Exchanger

Manufacturers data to quantify heat rejected to the space with the engine generator set at rated capacity.

Time-Delay on Alarms

The magnitude of monitored values which define alarm or action setpoints, and the tolerance (plus and/or minus) at which the device activates the alarm or action.

Cooling System

a. The maximum and minimum allowable inlet temperatures of the coolant fluid, cooling air.

b. The maximum allowable temperature rise in the coolant fluid through the engine, cooling air across the engine.

c. The minimum allowable inlet fuel temperature.

Manufacturer's Catalog

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate specification compliance.

Vibration Isolation

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

Instructions

Instructions including: the manufacturer's pre-start checklist and precautions; startup procedures for test mode, manual-start mode, and automatic-start mode, (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches). Instructions shall be weatherproof, laminated in plastic, framed, and posted where directed. Posted data shall include wiring and control diagrams showing the key mechanical and electrical control elements, and a diagrammatic layout of the system.

Experience

Statement showing that each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel-engine generator sets for commercial and industrial use. The engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

Field Engineer

A letter listing the qualifications, schools, formal training, and experience of the field engineer.

Site Welding

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their qualifications symbols.

General Installation

A complete copy of the manufacturer's installation procedures.

A detailed description of the manufacturer's recommended break-in procedure.

Site Visit

A site visit letter stating the date the site was visited and listing discrepancies found.

SD-06 Test Reports

Onsite Inspection and Tests

a. A letter giving notice of the proposed dates of all onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's proposed procedures for onsite tests including the test including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 14 days prior to beginning tests.

c. Six copies of the onsite test data described below in 8-1/2 by 11 inch 3-ring binders with a separate section for each test. Sections shall be separated by dividers with tabs. Data plots shall be full size 8-1/2 by 11 inches minimum), showing all grid lines, with full resolution.

(1) A description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) The parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of all adjustments made.

SD-07 Certificates

Vibration Isolation

Torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10%.

Prototype Tests

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability

Documentation which cites engines and generators in similar service to demonstrate compliance with the requirements of this specification. Certification does not exclude annual technological improvements made by a manufacturer in the basic standard model set on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets all the performance requirements of this specification. For each different set, 2 like sets shall have performed satisfactorily in a stationary power application, independent and separate from the physical location of the manufacturer's and assembler's facilities, for a minimum of 2 consecutive years without any failure to start, including periodic exercise. The certification shall state that for the set proposed to meet this specification, there were no failures resulting in downtime for repairs in excess of 72 hours or any failure due to overheating during 2 consecutive years of service. Like sets are of the same model, speed, bore, stroke, number and configuration of cylinders, and output power rating. Like generators are of the same model, speed, pitch, cooling, exciter, voltage regulator and output power rating. A list shall be provided with the name of the installations, completion dates, and name and telephone number of a point of contact.

Emissions

A certification from the engine manufacturer stating that the engine exhaust emissions meet federal, state, and local regulations and restrictions specified. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

Sound limitations

A certification from the manufacturer stating that the sound emissions meet the specification.

Current Balance

Manufacturer's certification that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

Materials and Equipment

A letter stating that where materials or equipment are specified to comply with requirements of UL, or other standards, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Factory Inspection and Tests

A certification that each engine generator set passed the factory tests and inspections and a list of the test and

inspections.

Inspections

A letter certifying that all facilities are complete and functional, that each system is fully functional, and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

Cooling System

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

1.3 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule.

1.3.1 Engine-Generator Parameter Schedule

ENGINE GENERATOR PARAMETER SCHEDULE

Service Load	kW
Power Factor	0.8 lagging
Motor Starting kVA (maximum)	_____ kVA
Maximum Speed	1800 rpm
Engine-Generator Application	stand-alone
Engine Cooling Type	water/ethylene glycol
Heat Exchanger Type	fin-tube, shell-tube
Governor Type	Isochronous
Frequency Bandwidth steady state	± _____, 0.25%
Governor Type	Droop
Frequency Regulation (droop) (No load to full load)	3 (max.)
Frequency Bandwidth (steady state)	± _____ 0.25%
Voltage Regulation (No load to full load)	± 2% (max.)
Voltage Bandwidth (steady state)	± 0.5, 2%

Frequency	60 Hz
Voltage	As indicated
Phases	As indicated
Minimum Generator Subtransient Reactance	_____ percent
Nonlinear Loads	_____ kVA
Max Step Load Increase	100% of Service Load at 0.8 PF
Max Step Load Decrease (without shutdown)	100 % of Service Load at _____ PF
Max Time to Start and be Ready to Assume Load	10 seconds

1.3.2 Output Capacity

Each generator set shall provide power equal to the sum of service load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

1.3.3 Power Rating

Standby ratings shall be in accordance with EGSA 101P.

1.4 GENERAL REQUIREMENTS

1.4.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter, mounted, assembled, and aligned on one base; and all other necessary ancillary equipment which may be mounted separately. Sets shall be assembled and attached to the base prior to shipping. Set components shall be environmentally suitable for the locations shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. A generator strip heater shall be provided for moisture control when the generator is not operating.

1.4.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number, and rating number on a plate secured to the equipment. As a minimum, nameplates shall be provided for: Engines; Relays; Generators; Day tanks; Transformers (CT & PT); Regulators; Pumps and pump motors; Governors; Generator Breaker; Economizers; Heat exchangers (other than base-mounted).

Engines	Relays
Generators	Day tanks

Transformers (CT & PT)	Regulators
Pumps and pump motors	Governors
Generator Breaker	Economizers
Heat exchangers (other than base-mounted)	

Where the following equipment is provided as a standard component by the diesel-engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Exhaust mufflers	Exciters
Switchgear	Silencers
Battery	

1.4.3 Personnel Safety Device

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel during normal operation shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

1.4.4 Site Visit

Before performing work, the premises shall be visited and details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies before performing any work.

1.4.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, the design, fabrication and installation shall conform to the code.

1.4.6 Site Welding

Structural members shall be welded in accordance with Section 05 05 23 WELDING, STRUCTURAL. For all other welding, procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1. Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. The Contracting Officer shall be notified 24 hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical. The welder or welding operator shall apply the assigned personal symbol near each weld made as a permanent record

1.4.7 Engine Generator Set Enclosure

The engine generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at rated load under secured conditions. Doors shall be provided for access to all controls and equipment requiring periodic maintenance or adjustment. Removable panels

shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

1.4.8 Vibration Isolation

The maximum engine-generator set vibration in the horizontal, vertical and axial directions shall be limited to 6 mils (peak-peak RMS), with an overall velocity limit of 0.95 inches/seconds RMS, for all speeds through 110% of rated speed. A vibration-isolation system shall be installed between the floor and the base. The vibration-isolation system shall limit the maximum vibration transmitted to the floor at all frequencies to a maximum of _____ (peak force). The engine-generator set shall be provided with vibration-isolation in accordance with the manufacturer's standard recommendation. Where the vibration-isolation system does not secure the base to the structure floor or unit foundation, seismic restraints shall be provided in accordance with the seismic parameters specified.

1.4.9 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacture/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

1.4.10 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine generator sets.

1.4.11 Seismic Requirements

Seismic requirements shall be in accordance with UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS and Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT and 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT as shown on the drawings.

1.4.12 Detailed Drawings

The Contractor shall submit detailed drawings showing the following:

a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.

b. Starting system.

c. Fuel system.

d. Cooling system.

e. Exhaust system.

f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.

g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.

h. Location, type, and description of vibration isolation devices.

i. The safety system, including wiring schematics.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.

k. Panel layouts.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set rigging points and lifting instructions.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 OPERATION AND MAINTENANCE MANUALS

The operation and maintenance manuals shall be submitted and approved prior to commencing onsite tests.

1.6.1 Operation Manual

Three copies of the manufacturers standard operation manual, operation manual in 8-1/2 by 11 inch three-ring binders shall be provided. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section. Drawings shall be folded blue lines, with the title block visible, and placed in 8-1/2 by 11 inch plastic pockets with reinforced holes. The manual shall include:

a. Step-by-step procedures for system startup, operation, and shutdown;

b. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;

c. Procedures for interface and interaction with related systems to include automatic transfer switches, fire alarm/suppression systems, load shedding systems, uninterruptible power supplies.

1.6.2 Maintenance Manual

Three copies of the maintenance manual containing the information described below in 8-1/2 x 11 inch three-ring binders shall be provided. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes. The manual shall include:

a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, take-down overhaul, and repair service manuals, with parts lists.

b. The manufacturer's recommended maintenance schedule.

c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components listed in paragraph GENERAL REQUIREMENTS.

d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7 SPECIAL TOOLS AND FILTERS

Two sets of special tools and two sets of filters required for maintenance shall be provided. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Two complete sets of filters shall be supplied in a suitable storage box. these filters shall be in addition to filters replaced after testing.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified.

2.1.1 Circuit Breakers, Low Voltage

NEMA AB 1 and UL 489.

2.1.2 Filter Elements (Fuel-oil, Lubricating-oil, and Combustion-air)

Manufacturer's standard.

2.1.3 Instrument Transformers

NEMA C12.11.

2.1.4 Pipe (Sleeves, Fuel/Lube-oil, Compressed-Air, Coolant and Exhaust)

ASTM A 53/A 53M, ASTM A 106/A 106M or ASTM A 135/A 135M, steel pipe. Pipe smaller than 2 inches shall be Schedule 80. Pipe 2 inches and larger shall be Schedule 40.

2.1.5 Pipe Flanges and Fittings

a. Pipe Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150, or ASME B16.11, 3000 lb.

c. Threaded Fittings: ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturers Standard.

2.1.6 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.7 Electrical Enclosures

2.1.7.1 General

NEMA ICS 6.

2.1.7.2 Panelboards

NEMA PB 1.

2.1.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings, a maximum speed of 1800 rpm and integral automatic or manual reset thermal overload protectors. Motors used indoors shall have drip proof frames; those used outside shall be totally enclosed. AC motors larger than 1/2 Hp shall be of the squirrel cage induction type for standard voltage of 200, 230, 460, 560 volts, 60 Hz, 240, 380 volts, 50 Hz three phase power. AC motors 1/2 Hp or smaller, shall be for standard voltage 115, 230 volts, 60 Hz, 110, 220, 240 volts, 50 Hz, single phase power.

2.1.9 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancilliaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, scavenged, supercharged or turbocharged. The engine shall be two- or four-stroke-cycle and compression-ignition type. The engine shall be vertical inline, V-, or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have no less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

2.3 FUEL SYSTEM

The fuel system for each engine generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary recirculation.

2.3.1.2 Auxiliary Fuel Pump

Auxiliary fuel pumps shall be provided to maintain the required engine fuel pressure, either required by the installation or indicated on the drawings. The auxiliary pump shall be driven by a dc electric motor powered by the starting/station batteries. The auxiliary pump shall be automatically actuated by a pressure detecting device.

2.3.2 Filter

A minimum of one full flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line, and prevent the build-up of excessive pressure in the fuel system.

2.3.4 Integral Main Fuel Storage Tank

Each engine shall be provided with an integral main fuel tank. Each tank shall be factory installed and provided as an integral part of the diesel generator manufacturer's product. Each tank shall be provided with connections for fuel supply line, fuel return line, local fuel fill port, gauge, vent line, and float switch assembly. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the tank shall be below the flash point of the fuel. Each engine-generator set provided with weatherproof enclosures shall have its tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.3.4.1 Capacity

Each tank shall have capacity as shown at 100% rated load without being refilled.

2.3.4.2 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.4.3 Fuel Level Controls

Each tank shall have a float-switch assembly to perform the following functions:

Activate the "Low Fuel Level" alarm at 70% of the rated tank capacity.

(2) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank capacity.

2.3.4.4 Arrangement

Integral tanks may allow gravity flow into the engine. Gravity flow tanks and any tank that allows a fuel level above the fuel injectors shall be provided with an internal or external factory installed valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. Integral day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The fuel supply line from the tank to the manufacturer's standard engine connection shall be welded pipe.

2.3.5 Day Tank

Each engine shall be provided with a separate self-supporting, integral day tank. Each day tank shall be provided with connections for fuel supply line, fuel return line, fuel overflow line, local fuel fill port, gauge, vent line, drain line, and float switch assembly for control. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the day tank shall be below the flash point of the fuel. A temperature sensing device shall be installed in the fuel supply line. Each day tank shall be provided with connections for fuel supply line, fuel overflow line, local fuel fill port, gauge, vent line, drain line, and float switch assembly for control. Each engine-generator set provided with weatherproof enclosures shall have its day tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.3.5.1 Capacity, Standby

Each day tank shall have capacity as shown at 100% rated load without being refilled, plus any fuel which may be returned to the main fuel storage tank. The calculation of the capacity of each day tank shall incorporate the requirement to stop the supply of fuel into the day tank at 90% of the ultimate volume of the tank.

2.3.5.2 Drain Line

Each day tank drain line shall be accessible and equipped with a shutoff valve. Self supporting day tanks shall be arranged to allow drainage into a 12 inch tall bucket.

2.3.5.3 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.5.4 Fuel Level Controls

Each day tank shall have a float-switch-assembly to perform the following functions:

(1) When the main storage tank is located higher than the day

tank, open the solenoid valve located on the fuel supply line entering the day tank and start the supply of fuel into the day tank Start the supply of fuel into the day tank when the fuel level is at the "Low" level mark, 75% of the rated tank capacity.

(2) When the main storage tank is located higher than the day tank, stop the supply of fuel into the day tank and close the solenoid valve located on the fuel supply line entering the day tank Stop the supply of fuel into the day tank when the fuel level is at 90% of the rated tank capacity.

(3) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank volume.

(4) Activate the "Low Fuel Level" alarm at 70% of the rated tank Capacity.

(5) Activate the automatic fuel supply shut-off valve located on the fill line of the day tank and shut down the fuel pump which supplies fuel to the day tank at 95% of the rated tank volume. The flow of fuel shall be stopped before any fuel can be forced into the fuel overflow line.

2.3.6 Fuel Supply System

The fuel supply from the main storage of fuel to the day tank shall be as specified in Section 33 56 10 FACTORY-FABRICATED FUEL STORAGE TANKS.

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven oil pumps. Each system shall be furnished with a relief valve for oil pressure regulation (for closed systems) and a dip-stick for oil level indications. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for required indication and alarms.

2.5 COOLING SYSTEM

Each engine cooling system shall operate automatically while the engine is

running. Each cooling system shall be sized for the maximum summer outdoor, indoor design temperature and site elevation. Water-cooled system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across the engine shall be no more than that recommended and submitted in accordance with paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

2.5.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in accordance with paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application.

2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film providing that corrosion measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via oversizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 7 psi. Each heat exchanger shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes. One tapped hole in the heat exchanger shall be equipped with a drain cock, the rest shall be plugged.

2.5.2.2 Shell and U-Tube Type Heat Exchanger

Heat exchanger shall be multiple pass shell and U-tube type. Exchanger shall operate with low temperature water in the shell and high temperature water in the tubes. Exchangers shall be constructed in accordance with ASME BPVC SEC VIII D1 and certified ASME stamp secured to the unit. U-tube bundles shall be completely removable for cleaning and tube replacement and shall be free to expand with the shell. Shells shall be constructed of seamless steel pipe or welded steel. Tubes shall be cupronickel or inhibited admiralty, constructed in accordance with ASTM B 395/B 395M, suitable for the temperature and pressure specified. Tubes shall be not less than 3/4 inch unless otherwise indicated. Shell side and tube side shall be designed for 150 psi working pressure and factory tested at 300 psi. High and low temperature water and pressure relief connections shall be located in accordance with the manufacturers standard practice. Water connections larger than 3 inches shall be ASME Class 150 flanged. Water pressure loss through clean tubes shall be as recommended by the engine manufacturer. Minimum water velocity through tubes shall be 1 foot per second and assure turbulent flow. One or more pressure relief valves shall be provided for each heat exchanger in accordance with ASME BPVC SEC VIII D1. The aggregate relieving capacity of the relief valves shall be not less

than that required by the above code. Discharge from the valves shall be installed as indicated. The relief valves shall be installed on the heat exchanger shell. A drain connection with 3/4 inch hose bib shall be installed at the lowest point in the system near the heat exchanger. Additional drain connection with threaded cap or plug shall be installed wherever required for thorough draining of the system.

2.5.3 Expansion Tank

The cooling system shall include an air expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The tank shall be suitable for an operating temperature of 250 degrees F and a working pressure of 125 psi. The tank shall be constructed of welded steel, tested and stamped in accordance with ASME BPVC SEC VIII D1 for the stated working pressure. A bladder type tank shall not be used. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installation.

2.5.4 Ductwork

Ductwork shall be as specified except that a flexible connection shall be used to connect the duct to the diesel engine radiator. Material for the connection shall be wire-reinforced glass. The connection shall be rendered practically airtight.

2.5.5 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 SOUND LIMITATIONS

The noise generated by the diesel generator set operating at 100 percent load shall not exceed the following sound pressure levels in any of the indicated frequencies when measured in a free field at a radial distance of 22.9 feet at 45 degrees apart in all directions.

Frequency Band (Hz)	Maximum Acceptable Pressure Level (Decibels)
31	As indicated
63	As indicated
125	As indicated
250	As indicated
500	As indicated
1,000	As indicated
2,000	As indicated
4,000	As indicated
8,000	As indicated

The noise generated by the installed diesel generator set operating at 100 percent load shall not exceed the following sound pressure levels in any of the indicated frequencies when measured at a distance of 75 feet from the end of the exhaust and air intake piping directly along the path of intake

and discharge for horizontal piping; or at a radius of 75 feet from the engine at 45 degrees apart in all directions for vertical piping.

Frequency Band (Hz)	Maximum Acceptable Pressure Level (Decibels)
31	As indicated
63	As indicated
125	As indicated
250	As indicated
500	As indicated
1,000	As indicated
2,000	As indicated
4,000	As indicated
8,000	As indicated

2.7 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer shall be capable of reducing the noise level at the air intake to a point below the maximum acceptable levels specified in paragraph SOUND LIMITATIONS. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be copper, rubber.

2.8 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported so as to minimize vibration. Where a V-type engine is provided, a V-type connector with necessary flexible sections and hardware shall connect the engine exhaust outlets.

2.8.1 Flexible Sections and Expansion Joints

A flexible section at each engine and an expansion joint at each muffler shall be provided. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.8.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside, inside, vertical, horizontal mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature 400 degrees F resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. The muffler shall have a drain valve, nipple, and cap at the

low-point of the muffler.

2.8.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a condensate trap and drain valve. Changes in direction shall be long-radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity operated, self-closing, rain cover.

2.9 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.

2.10 STARTING SYSTEM

The starting system for standby engine generator sets used in emergency applications shall be in accordance with NFPA 99 and NFPA 110 and as follows.

2.10.1 Controls

An engine control switch shall be provided with functions including: run/start (manual), off/reset, and automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cool down operation. The logic shall be arranged for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.10.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor, indoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15-second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.10.3 Functional Requirements

Starting system shall be manufacturers recommended dc system utilizing a negative circuit ground. Starting motors shall be in accordance with SAE ARP892.

2.10.4 Battery

A starting battery system shall be provided and shall include the battery, battery rack, intercell connectors, and spacers. The battery shall be in accordance with SAE J537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces specified. The battery shall be lead-acid type, with sufficient capacity, at the minimum outdoor/indoor winter temperature specified to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

2.10.5 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a float charge rate for maintaining the batteries in prime starting condition. An ammeter shall be provided to indicate charging rate. A timer shall be provided for the equalize charging rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

2.10.6 Starting Aids

The manufacturer shall provide one or more of the following methods to assist engine starting.

2.10.6.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of -25 degrees F.

2.10.6.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified.

2.11 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine generator set, without special tools, from 90 to 110 % of the rated speed/frequency, over a steady state load range of zero to 100% of rated capacity. Isochronous governors shall maintain the midpoint of the frequency bandwidth at the same value for steady-state loads over the range of zero to 100% of rated output capacity.

2.12 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class H, Class F. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 100 percent. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

2.12.1 Current Balance

At 100 percent rated load, and load impedance equal for each of the three

phases, the permissible current difference between any two phases shall not exceed 2 percent of the largest current on either of the two phases.

2.12.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated load, the difference in line-to-neutral voltage among the three phases shall not exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other two phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.12.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced full rated load at 0.8 power factor shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% at full rated load. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

2.13 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 104 degrees F ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

2.14 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine generator voltage output without special tools, during operation from 90 to 110% of the rated voltage over the steady state load range of zero to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 36 degrees F. The voltage regulator shall have a maximum droop of 2% of rated voltage over a load range from 0 to 100% of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.15 GENERATOR PROTECTION

Short circuit and overload protection for the generator shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit and interrupting current ratings to match the generator capacity. The manufacturer shall determine the short circuit current interrupting rating of the breaker. The breaker shall be engine generator base mounted by the engine-generator set manufacturer. Molded case breakers shall be provided with shunt trip. Surge protection shall be provided for each

phase of the generator, to be mounted at the generator terminals.

2.15.1 Panelboards

Panelboards shall be metal-enclosed, general purpose, 3-phase, 4-wire, 1-phase, 3-wire, 600 volt rated, with neutral bus and continuous ground bus, conforming to NEMA PB 1 and UL 891. Neutral bus and ground bus capacity shall be as shown, full capacity. Enclosure designs, construction, materials and coatings shall be as indicated, suitable for the application and environment. Bus continuous current rating shall be at least equal to the generator rating and correspond to UL listed current ratings specified for panelboards and switchboards, as indicated. Current withstand rating (short circuit rating) shall match the generator capacity. Buses shall be copper.

2.15.2 Devices

Switches, circuit breakers, switchgear, fuses, relays, and other protective devices shall be as specified in Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.

2.16 SAFETY SYSTEM

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgement and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.16.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 10 feet. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.16.2 Visual Signal Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously light upon acknowledgement. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.16.3 Alarms and Action Logic

2.16.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers shall be accomplished.

2.16.3.2 Problem

Activation of the visual signal shall be accomplished.

2.16.4 Local Alarm Panel

A local alarm panel shall be provided with the following shutdown and alarm functions as indicated, in accordance with NFPA 99, 110 level 1, 2 and including the listed Corps of Engineers requirements, mounted either on or adjacent to the engine generator set.

Device/ Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required
Shutdowns W/Alarms					
High engine temperature	Automatic/ jacket water/ cylinder	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Low lube-oil pressure	Automatic/ pressure/ level	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Overspeed shutdown $ alarm	(110% (± 2%) of rated speed	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Overcrank failure to start	Automatic/ Failure to to start	SD/CP VA	SD/CP VA	SD/CP VA	
Air shutdown damper (200-600kW)	When used		SD/CP VA	SD/CP VA	
Day tank overfill limit indication & transfer pump shutdown (95% volume)	Automatic/Day Tank/Level				SD/OPA (Pump)
Red emergency stop switch	Manual Switch		SD/CP VA	SD/CP VA	SD VA
Failure to crank	Corps of Engrs. Required				
Day tank Integral Main Fuel Tank low fuel limit Device/ Condition/ indication (70% volume remaining)	Corps of Engrs. Required				

Device/ Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required
Alarms					
Low lube-oil pressure	Pressure/ level	CP VA	CP VA	CP VAO	CP VA
Low fuel level	Main tank, 3 hours remaining	VA/AA	CP VA	CP VAO	
High fuel level	Integral Main Fuel Storage Tank 95% Volume				CP VA
Low coolant	Jacket water	CP/VA	CP VA	CP VA	
Pre-high temperature	Jacket water/ cylinder	CP VA	CP VA	CP VAO	CP VA
Pre-low lube-oil pressure		CP VA			CP VA
High battery voltage			CP VA	CP VAO	
Low battery voltage			CP VA	CP VAO	
Battery charger AC failure	AC supply not available		CP VA	CP VAO	
Control switch not in AUTO			CP VA	CP VAO	
Low starting air pressure			CP VA	CP VAO	
Low starting hydraulic pressure			CP VA	CP VAO	

SD - Shut Down
CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional

2.16.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay

device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.16.6 Remote Alarm Panel

A remote alarm panel shall be provided as indicated and as follows:

Device/Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2
Remote annunciator panel	Battery powered		Alarms	
Loads on genset		VA		
Battery charger malfunction		VA		
Low lube-oil	Pressure/level	VA/AA	AA	AAO
Low Temperature	Jacket water	VA/AA	AA	AAO
High Temperature	Jacket water/ cylinder	VA/AA	AA	AAO
Low fuel level	Main tank, 3 hr remaining	VA/AA	AA	AAO
Overcrank	Failure to start	VA/AA	AA	AAO
Overspeed		VA/AA	AA	AAO
Pre-high temperature	Jacket water/ cylinder		AA	
Control switch not in AUTO			AA	
Common alarm contacts for local & remote common alarm			X	X
Audible alarm silencing switch			X	O
Air shutdown damper	When used		AA	AAO
Common fault alarm			AA	

X - Required
SD - Shut Down
CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional

2.17 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

2.17.1 Controls

A local control panel shall be provided with controls as indicated and as follows, mounted as indicated. A remote control panel shall be provided with devices as indicated .

Device/Condition/ Function	Corps Requirement	NFPA 110 Level 1	NFPA 110 Level 2	MFG Offering
Controls				
Switch: run/start - off/set - auto	CP			CP/STD
Emergency stop switch & alarm	CP			CP/STD
Lamp test/indicator test	CP	CP VA	CP VA	CP/STD
Common alarm contacts/ fault relay		X	X	CP/O
Panel lighting	CP			CP/STD
Audible alarm & silencing/reset switch	CP			
Voltage adjust for voltage Regulator	CP			CP/STD
Pyrometer display w/selector switch	CP			
Remote emergency stop switch		CP VA	CP VA	
Remote fuel shutoff switch				
Remote lube-oil shutoff switch				

2.17.2 Engine Generator Set Metering and Status Indication

A local panel shall be provided with devices as indicated and as follows mounted as indicated. A remote control panel shall be provided with devices as indicated.

Device/Condition/ Function	Corps Requirement	NFPA 110 Level 1	NFPA 110 Level 2	MFG Offering
Genset Status & Metering				
Genset supplying load		CP VA	CP VAO	CP VAO
System ready				CP/STD
Engine oil pressure	CP			CP/STD
Engine coolant temperature	CP			CP/STD
Engine RPM (Tachometer)	CP			CP/STD

Device/Condition/ Function	Corps Requirement	NFPA 110 Level 1	NFPA 110 Level 2	MFG Offering
Engine run hours	CP			CP/STD
Pyrometer display w/selector switch	CP			
AC volts (generator), 3-phase	CP			CP/STD
AC amps (generator), 3-phase	CP			CP/STD
Generator frequency	CP			CP/STD
Phase selector switches (amps & volts)	CP			CP/STD
Watts/kW				CP/VA-O
Voltage Regulator Adjustment	CP			

CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional
STD - Manufacturers Standard Offering

2.18 PANELS

Each panel shall be of the type necessary to provide specified functions. Panels shall be mounted on the engine generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush. Convenient access to the back of instruments shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function as indicated. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Panels except the remote alarm panel can be combined into a single panel.

2.18.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6, and provided with locking mechanisms which are keyed alike.

2.18.2 Analog

Analog electrical indicating instruments shall be in accordance with ANSI C39.1 with semiflush mounting. Switchgear, and control-room panel-mounted instruments shall have 250 degree scales with an accuracy of not less than 1 percent. Unit-mounted instruments shall be the manufacturer's standard with an accuracy of not less than 2 percent. The instrument's operating temperature range shall be minus 4 to plus 130 degrees F. Distorted generator output voltage waveform of a crest factor less than 5 shall not affect metering accuracy for phase voltages, hertz

and amps.

2.18.3 Electronic

Electronic indicating instruments shall be true RMS indicating, 100 percent solid state, microprocessor controlled to provide all specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 2 percent for unit mounted devices and 1 percent for control room, panel mounted devices, throughout a temperature range of minus 4 to plus 130 degrees F. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 1/2 inch.

2.18.4 Parameter Display

Indication or readouts of the lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and coolant temperature.

2.18.5 Exerciser

The exerciser shall be in accordance with Section 26 36 00.00 10 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.19 SURGE PROTECTION

Electrical and electronic components shall be protected from, or designed to withstand the effects of surges from switching and lightning.

2.20 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and source transfer upon loss of normal, preferred source; retransfer upon restoration of the normal, preferred source; sequential starting; and stopping of each engine-generator set after cool down. Devices shall automatically reset after termination of their function.

2.20.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 26 36 00.00 10 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.20.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Functions, actuation, and time delays shall be as described in Section 26 36 00.00 10 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.21 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set.

2.22 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment will be maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall be provided with suitable holes for foundation bolts. The base shall also withstand and mitigate the effects of synchronous vibration of the engine and generator, and shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

2.23 THERMAL INSULATION

Thermal insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.24 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.25 FACTORY INSPECTION AND TESTS

Factory inspection and tests shall be performed on each engine-generator set proposed to meet this specification section. Inspections shall be completed and necessary repairs made prior to testing. Inspectors shall look for leaks, looseness, defects in components, and proper assembly. Factory tests shall be NEMA MG 1 routine tests and the manufacturers routine tests.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

3.2.1 General

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturer's standard connection is threaded. Except as otherwise specified, flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to all equipment shall be made with flexible connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors, and openings to permit thermal expansion and contraction without damage to joints or hangers, and with a 1/2 inch drain valve at each low point.

3.2.2 Supports

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 7 feet on center for pipes 2 inches in diameter or less, not more than 12 feet on center for pipes larger than 2 inches but no larger than 4 inches, and not more than 17 feet on center for pipes larger than 4 inches in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.2.1 Ceiling and Roof

Exhaust piping shall be supported with appropriately sized type 41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized type 1 clevis and threaded rods.

3.2.2.2 Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized type 33 brackets with the appropriate ceiling and roof pipe supports.

3.2.3 Flanged Joints

Flanges shall be 125 pound type, drilled, and of the proper size and configuration to match equipment and diesel-engine connections. Gaskets shall be factory cut in one piece 1/16 inch thick.

3.2.4 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of all debris.

3.2.5 Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be 1/2 inch, and where pipes pass through combustible materials, 1 inch larger than the outside diameter of the passing pipe or pipe covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. For vibration isolation, flexible fittings shall be provided for all conduit, cable trays, and raceways attached to engine-generator sets; metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor; and terminations of conductors on the engine generator set shall be crimp-type terminals or lugs. The Contractor shall submit proof of prototype tests as specified in the Submittals paragraph.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments or replacements shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be taken during engine-generator set operation and recorded in 15 minute intervals and shall include: readings of engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions and terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE Std 1.

3.5.1.2 Power Factor

Engine-generator set operating tests shall be made utilizing a load with the power factor specified in the engine generator set parameter schedule.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide all equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments, provided under this specification shall be verified during test runs by test instruments of precision and accuracy greater than the tested items. Test instrument accuracy shall be at least as follows: current, 1.5%; voltage, 1.5%; real power, 1.5%; reactive power, 1.5%; power factor, 3%; frequency, 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 30, 90 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance in authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however the following general order of testing shall be followed: Construction Tests; Inspections; Safety run Tests; and Performance Tests and Final Inspection.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Piping Test

a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.

b. Fuel piping which is external to the engine-generator set shall be tested in accordance with NFPA 30. All remaining piping which is external to the engine generator set shall be pressure tested with air pressure at 150% of the maximum anticipated working pressure, but in no case less than 150 psig, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the automatic transfer switch. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

1) R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters).

2) (R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

3) Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

b. Ground-Resistance Tests. The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

1) Single rod electrode - 25 ohms.
2) Multiple rod electrodes - 25 ohms.
3) Ground mat - 25 ohms.

c. Circuit breakers and switchgear shall be examined and tested in accordance with manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)
15. Lube oil drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil-fill level. (I)
18. Lube-oil line connections. (I)
19. Lube-oil lines. (I)
20. Fuel type. (D)
21. Fuel-level. (I)
22. Fuel-line connections. (I)
23. Fuel lines. (I)
24. Fuel filter. (I)
25. Access for maintenance. (I)
26. Voltage regulator. (I)
27. Battery-charger connections. (I)
28. Wiring & terminations. (I)
29. Instrumentation. (I)
30. Hazards to personnel. (I)
31. Base. (I)
32. Nameplates. (I)
33. Paint. (I)
34. Exhaust system. (I)
35. Access provided to controls. (I)
36. Enclosure. (I)
37. Engine & generator mounting bolts (proper application). (I)

3.5.4 Safety Run Tests

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and verify that the engine stops.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary, provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If temperature reading exceeds the value for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily seal their normal location on the engine and temporarily install temperature gauges in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 30 minutes at 100 percent of service load.

l. Verify proper operation of the governor and voltage regulator.

m. Verify proper operation and setpoints of gauges and instruments.

n. Verify proper operation of ancillary equipment.

o. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

p. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of rated load.

q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.

r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine. Record the results.

s. Attach a manifold to the engine oil system (at the oil sensor pressure port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.

t. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of service load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100% of service load. Record the maximum sound level in each frequency band at a distance of 75 feet from the end of the exhaust and air intake piping directly along the path of intake and discharge horizontal piping; or at a radius of 35 feet from the engine at 45 degrees apart in all directions for vertical piping. The measurements should comply with the paragraph SOUND LIMITATIONS. If a sound limiting enclosure is provided, the enclosure, the muffler, and intake silencer shall be modified or replaced as required to meet the sound requirements contained within this specification.

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

3.5.5 Performance Tests

3.5.5.1 Continuous Engine Load Run Test

The engine-generator set and ancillary systems shall be tested at service load to: demonstrate reliability and durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. The engine load run test shall be accomplished principally during daylight hours, with an average ambient temperature as indicated. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Data taken at 15 minutes intervals shall include the following:

a. Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

b. Pressure: Lube-oil.

c. Temperature: Coolant, Lube-oil, Ambient.

(1) Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

(2) Start the engine; make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

(3) Operate the engine generator-set for at least 2 hours at 75 percent of service load.

(4) Increase load to 100%of service load and operate the engine generator-set for at least 2 hours.

(5) Remove load from the engine-generator set.

3.5.5.2 Load Acceptance Test

Engine manufacturer's recommended prestarting checks and inspections shall be performed and recorded. The engine shall be started, and engine manufacturer's after-starting checks and inspections made and recorded during a reasonable warm-up period. For the following steps, the output line-line and line-neutral voltages and frequency shall be recorded after performing each step instruction (after stabilization of voltage and frequency). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

a. Apply load in steps no larger than the Maximum Step Load Increase to load the engine-generator set to 100 of Service Load.

b. Verify that the engine-generator set responds to the load addition and that the output voltage returns to and stabilizes within the rated bandwidths.

3.5.6 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting, and loading and unloading of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

a. Ambient temperature (at 15 minute intervals).

b. Generator output current (before and after load changes).

c. Generator output voltage (before and after load changes).

d. Generator output frequency (before and after load changes.)

1. Initiate loss of the primary power source and verify automatic sequence of operation.

2. Restore the primary power source and verify sequence of operation.

3. Verify resetting of controls to normal.

3.6 FINAL INSPECTION AND TESTING

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the maximum step load increase to 100% of service load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period. Perform the pre-test inspections and take necessary corrective actions.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 4 hours at service load, then re-examining the oil and filter.

e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.7 MANUFACTURER'S FIELD SERVICE

3.7.1 Onsite Training

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations such as oil change, oil filter change, and air filter change.

3.7.2 Manufacturer's Representative

The engine generator-set manufacturer shall furnish a qualified representative to supervise the installation of the engine generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.8 INSTRUCTIONS

Two sets of instructions shall be typed in 8 1/2 x 11 inches format, laminated in weatherproof plastic, and placed in three-ring vinyl binders. The binders shall be placed as directed by the Contracting Officer. The instructions shall be in place prior to acceptance of the engine generator set installation. First set of instructions shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.9 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and after all defects in installation material or operation have been corrected.

-- End of Section --

SECTION 26 32 15

DIESEL ENGINE-GENERATOR SETS - PRIME AND STANDBY - 10 TO 500 KW

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.16	(1997) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Electrical Analog Indicating Instruments
ANSI S1.4 (ASA 47)	(1983; R 1994) Sound Level Meters

ASME INTERNATIONAL (ASME)

ASME B15.1	(1996) Mechanical Power Transmission Apparatus
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B31.9	(1996) Building Services Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1998) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 181/A 181M	(1995; Rev. B) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 193/A 193M	(1997; Rev. A) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 234/A 234M	(1998; Rev. B) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate

	and High Temperatures Service
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
29 CFR 1910	Occupational Safety and Health Standards
INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)	
ICBO Building Code	(1994) Uniform Building Code
INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)	
IEC 34	Rotating Electrical Machines Part 2: Methods for Determining Losses and Efficiency of Rotating Electrical Machinery from Tests (Excluding Machines for Traction Vehicles)
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)	
IEEE Std 115	(1995) Synchronous Machines
IEEE Std 421.1	(1986; R 1996) Definitions for Excitation Systems for Synchronous Machines
IEEE C37.2	(1996) Electrical Power System Device Function Numbers
IEEE C37.13	(1990) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C57.13	(1993) Instrument Transformers
U.S. DEPARTMENT OF DEFENSE (DOD)	
MIL-T-5544	(Rev. C) Thread Compound, Antiseize, Graphite-Petrolatum
MIL-T-22361	(Am. 1) Thread Compound; Antiseize, Zinc Dust-Petrolatum
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)	
NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA MG 1	(1993; Rev. 1-4) Motors and Generators
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 30	(1996) Flammable and Combustible Liquids Code
NFPA 37	(1998) Installation and Use of Stationary Combustion Engines and Gas Turbines

NFPA 70	(1999) National Electrical Code
NFPA 99	(1996) Health Care Facilities

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA DCS	(1985) HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES (UL)

UL 489	(1996; R 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 1236	(1994; R 1999) Battery Chargers for Charging Engine-Starter Batteries

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Intercooling - Cooling of charged air after it leaves turbocharger compressor.

b. IEEE Device Numbers - Described in IEEE Standard IEEE C37.2.

c. Gross and Net Bhp Ratings of Engine - Gross rating shall be total rated power output before deducting power requirements of electric motor-driven equipment. Net ratings shall be equal to gross ratings minus total power requirements of electric motor-driven accessories normally constituting part of "engine assembly."

1.4 SYSTEM DESIGN

1.4.1 Engine-Generator Set Data

Submit the following data pertaining to each engine-generator set.

a. Manufacturer of engine

b. Type or model of engine

c. Gross bhp rating of engine

d. Net bhp rating of engine

e. Strokes per cycle

f. Number of cylinders

g. Bore and stroke, inches

h. Engine speed, rpm

i. Piston speed, fpm

j. BMEP at full load (psig)

k. kW rating of generator set at specified voltage and temperature rise per NEMA MG 1

l. kVA rating of generator and power factor

m. Induction method (naturally aspirated, turbocharged)

n. Intercooler type (air-to-air or jacket water)

o. Governor type, make and model

p. Make and model of turbochargers

q. Motor starting kVA of generator set at 35 percent dip for voltage specified

1.5 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Engine-generator unit and auxiliary equipment

Engine-generator unit electrical drawings

SD-03 Product Data

Engine-generator set

Engine-generator unit guarantees

Diesel engines

Generator and exciter

SD-05 Design Data

Torsional vibrations analysis for each unit

Parallel operation verification

SD-06 Test Reports

Preliminary operation

Phase relationship tests

Control panel and switchboard tests

Engine-generator set acceptance tests

Auxiliary equipment test

Submit test and inspection reports for work required under paragraph, "Field Quality Control."

SD-07 Certificates

Diesel engine generator successful operation

Field welding procedures

SD-09 Manufacturer's Field Reports

Engine-generator set tests

Submit certified factory test report within 15 calendar days after completion of tests. Provide in accordance with requirements set forth in paragraph entitled "Source Quality Control."

SD-10 Operation and Maintenance Data

Engine-generator unit and auxiliary equipment, Data Package 4

Engine speed governing system, Data Package 3

Engine-generator set voltage regulator, Data Package 5

Engine control panel, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23, "Operation and Maintenance Data."

SD-11 Closeout Submittals

Posted operating instructions for diesel engine-generator set

Provide text for each piece of equipment according to paragraph, "POSTED OPERATING INSTRUCTIONS."

1.6 QUALITY ASSURANCE

1.6.1 Experience Requirements

Engines installed shall meet the following operating experience requirements:

a. Only electric generation service is considered equivalent experience. Engines driving pumps, compressors, or those in marine propulsion or railroad service are not acceptable.

b. Only experience on the same engine model is acceptable. Engine model is considered to be a given series or class of identical bore and stroke and of the same type of engine, such as In-line or Vee. In-line and Vee engines with identical bore and stroke are considered as two separate models.

c. Only experience at identical or higher rotative speed as that specified is acceptable.

d. Only experience at identical or higher BMEP as that specified is acceptable.

e. Only experience with diesel-fueled engines is acceptable.

1.6.2 Regulatory Requirements

a. Provide devices designed and installed to comply with the following requirements:

(1) Power Transmission Apparatus: Guard in accordance with ASME B15.1.

(2) Electrical Installations: Conform to NFPA 70.

(3) Operator Protection: Guard in accordance with 29 CFR 1910as follows:

(a) Fan blades: Part 1910, Subpart O

(4) Mercury: Use of mercury in instruments, contacts, and manometers is not permitted.

b. File inspection certificates for compressed air storage system with proper authorities as may be required by law and furnish a copy to the Contracting Officer.

1.6.3 Drawing Requirements

1.6.3.1 Engine-Generator Unit and Auxiliary Equipment

Submit outline and installation drawings or catalog cuts containing installation details.

a. Certified outline, general arrangement (setting plan), and anchor bolt details. Show total weight and center of gravity of assembled equipment on the steel subbase.

b. General arrangement and detail piping of exhaust and air intake piping systems, and cooling piping details of units having remote cooling radiators.

c. General arrangement, size, and location of electrical interface points, and detailed elementary, schematic wiring, and interconnection diagrams of generator, exciter, governor, and other integral devices.

d. Dimensional drawings or catalog cuts of exhaust and intake silencers, intake filters, pumps, tanks, remote radiators, starting equipment, and other auxiliary equipment not integral with the generator set.

e. General arrangement or assembly drawings showing location of major auxiliary equipment in relation to the engine-generator set.

f. Piping schematics for fuel oil and engine coolant showing pipe sizes and valve locations.

g. Engine-generator control panel.

1.6.3.2 Engine-Generator Unit Electrical Drawings

Submit electrical drawings including elementary, schematic, wiring, and interconnection diagrams for the generator switchboard.

1.6.4 Diesel Engine Generator Successful Operation

Submit certificates within 30 calendar days after award certifying that not less than three engines of identical number of cylinders and cylinder size, identical or higher rotative speed, up to a maximum of 1,800 rpm, and identical or higher brake mean effective pressure (BMEP), and the same basic configuration (In-line or Vee) as the engine to be provided, have each driven generators which have produced, in satisfactory operation, not less than 2,000 kWh of electricity for each kW of generator nameplate capability within a 2-year period. Certificates shall include:

a. A list of at least three engine-generator set installations meeting experience requirements in paragraph entitled "Experience Requirements."

b. Owner and location of each installation.

c. Date of initial operation of each installation.

d. Number of kWh produced per kW of generator net rated capability of each engine installation.

e. Horsepower rating, kW rating, and rotative speed of each set.

f. BMEP rating of each engine.

g. Design characteristics of each unit, such as bore and stroke, number of cylinders, and configuration (In-line or Vee).

1.6.5 Field Welding Procedures (Piping)

Before performing field welding, submit to the Contracting Officer, welding procedure specifications for metals included in the work, with proof of qualification as outlined in ASME B31.9.

71.7 DELIVERY, STORAGE AND HANDLING

Deliver equipment on pallets or blocking with each entire unit wrapped in heavy-duty plastic wrapping, sealed to protect unit from moisture and dirt. Plug and seal shut piping, conduit, exhaust, and air intake openings. Pack generator switchboard in shipping sections which can be handled and installed at the site. Protect and prepare batteries for shipment as recommended by battery manufacturer. Store equipment at the site in covered enclosures, protected from atmospheric moisture, dirt, and ground water. Properly label each package on exterior of wrapping to identify enclosed equipment, contract number, manufacturer, and purchaser. Manufacturer's standard practice in product protection and identification, meeting above requirements, is acceptable.

1.8 SITE CONDITIONS

The components of the engine-generator sets, including cooling system components, pumps, fans, and similar auxiliaries, shall be capable of the specified outputs in the following environment:

a. Site location: Coastal Sub-tropical

b. Site elevation: Sea level.

c. Ambient temperatures:

(1) Maximum 104 degrees F dry bulb, 85 degrees F wet bulb.

(2) Minimum 0 degrees F dry bulb.

d. Seismic zone: I as defined by ICBO Building Code.

e. Design wind velocity: 120 mph.

f. Prevailing wind direction: South.

g. Atmospheric conditions: Moist, Dust-laden, Corrosive.

h. Engine-generator set location: As indicated.

1.9 EXTRA MATERIAL

1.9.1 Paint

Furnish 12 cans of spray paint of identical paint used on engine-generator assembly in paint manufacturer's sealed container with each engine-generator set.

1.9.2 Filters

Furnish two spare replacement elements in their original containers for each filter with each unit.

1.10 POSTED OPERATING INSTRUCTIONS

Provide operating instructions laminated between matte-surface thermoplastic sheets suitable for placement adjacent to corresponding equipment. Install operating instructions where directed.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials and equipment of manufacturers regularly engaged in production of such materials or equipment, and the manufacturer's latest standard commercial product that complies with specification requirements. Where two units of the same class of equipment are required, these units shall be products of a single manufacturer; however, component parts of the system need not be products of the same manufacturer.

2.2 ENGINE-GENERATOR SET

Provide engine-generator sets, correctly coordinated by engine-generator manufacturer to ensure an installed rating in the environment described in paragraph entitled "Site Conditions." Each set shall consist of a water cooled diesel engine direct-connected to an ac generator having a brushless excitation system, and shall be provided with necessary accessories, auxiliaries, appurtenances, control equipment, and cooling systems,

resulting in a complete set and, except for external service connections, ready for operation. Mount each engine-generator set on a steel subbase sized to support the engine; generator-exciter, engine-generator control panel; lubricating oil filters, heat exchangers and pump; fuel oil filters, day tanks, and pumps; jacket coolant heat exchangers and pumps; and interconnecting piping and wiring. Engine unit-mounted radiators and auxiliaries shall be mounted on engine-generator set subbase. Engine-generator set shall include electric starters, controls, and related wiring for electric starting. Batteries, battery racks and charger assembly may be mounted on the set subbase. Provide subbase with vibration isolators suitable for loads and lateral forces involved in seismic zone indicated. Isolators shall be as recommended by engine-generator set and isolator manufacturers to suit specific equipment involved. Make electrical and mechanical field connections with flexible connectors. When standard with the manufacturer, combustion air filter/silencer units and exhaust muffler units may be mounted separately from the set, and connections made to engine with corrosion-resistant flexible connections. Factory align engines and generators on subbase and securely bolt into place in accordance with manufacturer's standard practice. Paint each set, after assembly, with manufacturer's standard paints and colors. After tests and before shipping, thoroughly clean each set and retouch paint as necessary to provide complete protection to the set. Arrange sets for automatic unattended starting in addition to manual start-and-stop by control panel switches. Each engine-generator set shall be capable of automatically starting, coming up to synchronous speed, and ready to accept full rated power within 10 seconds after receipt of start signal. House each engine-generator set in a weather resistant enclosure for outdoor installation.

2.2.1 Equipment Rating and Capability

Each engine-generator set shall have a net standby, prime rating capacity as indicated and shall be designed to supply 480Y/277, 208Y/120-volt, 60-Hz ac output. Motor starting KVA shall be as indicated, based on a sustained RMS voltage drop as indicated of no-load voltage. Both engine and generator of the set shall be capable of satisfactorily carrying a load 10 percent in excess of net rated generating capacity at 0.8 power factor for a period of 2 continuous hours out of 24 consecutive hours. Auxiliary equipment shall be designed for continuous duty at 110, 100 percent of rated net capacity of engine-generator set. Cooling system components and auxiliaries shall be properly sized relative to engine coolant specified under cooling system.

2.2.2 Torsional Vibrations

Each complete engine-generator set shall be free of torsional vibrations that might endanger satisfactory operation of the set. Satisfactory operation will be considered endangered, when torsional vibration stresses exceed 5,000 psi within 10 percent above or below rated engine speed. Analysis of torsional vibrations shall be accomplished by calculations and by tests of a complete representative prototype of the engine-generator set. Results of the analysis shall be certified by a registered professional engineer.

2.3 GENERATOR SET DESIGN AND CONSTRUCTION

Isolate or shield rotating or reciprocating parts, or other parts that present a potential hazard to operating personnel.

2.3.1 Space Heaters

Space heaters shall be thermostatically controlled or constant-on and provided in the enclosures of generators, exciters, and outdoor motors. Heaters shall maintain a temperature inside the enclosure of not less than 10 degrees F above ambient at all times. Heaters shall be 120-vac, single-phase, of ratings as recommended by the manufacturer for the atmosphere specified under the paragraph entitled "Site Conditions."

2.4 DIESEL ENGINES AND ACCESSORIES

Engines shall be two-cycle, naturally aspirated, turbocharged, or turbocharged and intercooled; or four-cycle, naturally aspirated, turbocharged or turbocharged and intercooled; vertical In-line or vertical Vee type; water cooled; designed for continuous electrical duty, stationary service. Provide each engine designed and constructed to eliminate undue heating, vibration, and wear and be efficient and trouble free in operation. Engine shall be capable of operating on diesel fuel oil as indicated . Limiting characteristics of the engines shall be as follows:

a. Maximum BMEP, psi:

	Naturally Aspirated	Turbocharged	Turbocharged and Intercooled
Two-cycle engines	As Indicated	As Indicated	As Indicated
Four-cycle engines	As Indicated	As Indicated	As Indicated

b. Maximum engine speed, rpm: 1800

2.4.1 Construction

Construct engine to withstand sudden changes from no load to rated load, and to preserve alignment of integral components under all conditions of operation. Design shall incorporate pressure lubrication of bearings and wrist pins, and bearing journals shall be hardened or chromium plated to provide a hard shock-resistant surface with ductile core. Counterbalance crankshafts to reduce vibration to a minimum. Crankshaft and connecting rod bearings shall be replaceable precision sleeve type. Provide cylinders with replaceable liners. Construct piston rings of heat-resisting alloy steel or chromium plated cast-iron. Camshafts shall be gear driven, and shall be high wear-resistant, at cams and journals. Clearly indicate timing marks on crankshaft and gears. Valves shall have removable or rebuildable stem guides and seat inserts. Flywheel shall be balanced, and capable of being rotated 50 percent above the maximum rated engine rotative speed without danger of breaking or exploding. Provide flywheel housing with a drain hole at the lowest point. Provide means for turning crankshaft manually. Turbocharger lubricating oil system shall not be a separate system, but shall be a part of engine lubricating oil system.

2.4.2 Assembly

Completely factory-assemble each engine. Mount turbocharger or mechanically driven supercharger and intercooler and piping integral with

the engine, on the engine.

2.4.3 Engine Speed Governing System, IEEE Device 65

Provide each engine with a speed governing system and an independently driven overspeed limiting engine shutdown device. Provide an adjustable isochronous governor, with suitable speed sensing. Governor shall be capable of automatically dividing the load when paralleling with an infinite bus for the purpose of transferring load without interruption to the commercial electric service, and shall maintain specified stability without hunting, cycling, or other irregularities. Governor shall include provisions for adjusting speed droop and speed while the unit is in operation. Governor characteristics shall conform to the following:

a. Minus 10 to plus 5 percent minimum range of speed changer expressed as a percent of rated speed.

b. Steady-state governing speed band shall not exceed plus or minus 0.25 percent expressed as a percent deviation from rated speed.

c. Transient speed deviation shall not exceed plus or minus 3.0 percent expressed as a percent of rated speed for any 50 percent load step, on or off.

d. Time to return to limits of observed speed band shall not exceed 3 seconds after sudden load change of transient speed deviation.

e. 0 percent to 5 percent minimum manual speed regulation range adjustment, expressed as a percent of rated speed.

2.4.4 Engine Protective Devices

Provide each engine with protective devices as follows:

a. Engine Shutdown: Equip each engine with shutdown devices listed. These devices shall shut down the engine by shutting off the fuel supply to fuel injectors. Shutdown devices shall be positive, direct in action and independent of the governor. Shutdown devices shall have factory-set fixed set points and shall be equipped with either auxiliary electrical contacts, relays or equivalent device for shutdown. Auxiliary contacts shall be suitable for control battery voltage. Shutdown shall open the generator main circuit breaker. Provide the following shutdown devices:

(1) Overspeed device which operates when engine speed exceeds normal synchronous speed by 18 percent. Device shall require manual reset.

(2) Pressure switch which operates when engine and turbocharger lubricating oil pressure drops below a preset value.

(3) Temperature switch which operates when jacket coolant temperature exceeds a preset value.

(4) Other shutdown devices as recommended or normally provided by engine manufacturer.

b. Electrical Interlocks and Alarms: Equip starting mechanism with

auxiliary contacts for interlocking with generator main breaker control circuit as determined by manufacturer. Auxiliary contacts shall be suitable for control battery voltage.

2.4.5 Engine Alarm Contact Devices

Equip each engine with alarm devices, relays, and auxiliary contacts, as required, to actuate alarm system on associated engine control panel. Auxiliary contacts shall be suitable for control battery voltage. Alarm devices shall have factory-set fixed set points. Provide following alarm contact devices:

a. Starting mechanism contacts or equivalent device operating to energize a portion of alarm system only when engine is running and not during cranking or shutdown.

b. Pressure switch in engine and turbocharger lubricating oil system piping from engine to operate when pressure drops below a preset value due to failure of engine-driven lubricating oil pump. In addition to alarm contacts, provide set of contacts to start an auxiliary oil pump, when such a pump is standard with engine manufacturer.

c. Temperature switch in jacket coolant discharge piping from engine to operate when temperature exceeds a preset value.

d. Other alarm devices as recommended by engine manufacturer.

2.4.6 Engine Accessories

Provide the following accessories for each engine-generator set when recommended by the manufacturer:

a. Piping on engine-generator set to inlet and outlet connections, including nonstandard companion flanges.

b. Foundation bolts, nuts, isolators, and sleeves for engine-generator set.

c. Leveling jack screws or shims, when applicable.

d. Chocks and shims for installation and leveling of engine-generator set subbase, when applicable.

e. Manually operated barring gear.

f. Indicating thermometer or temperature indicator in accordance with manufacturer's standard for engine coolant.

2.4.7 Air Intake and Exhaust Systems

Provide air intake and exhaust systems for each engine. Install field piping in accordance with manufacturer's requirements. Mount air intake and exhaust systems on or support from engine subbase assembly. Arrangement of air intake and exhaust systems shall be similar to that indicated and modified, as required, to suit engine furnished, subject to approval of the Contracting Officer. For two-cycle engines, provide an air intake shutoff operated by engine overspeed device.

a. Air intake filters: Provide dry type filter for each engine as standard with the engine manufacturer. Size filter to suit engine requirements at 110 percent of rated full load. Unit shall be designed to permit easy access to filter for maintenance purposes.

b. Exhaust silencers: Provide an exhaust silencer for each engine to reduce the exhaust sound spectrum to, or below, the following listed levels, when measured with a sound level meter conforming to ANSI S1.4 (ASA 47), Type 1 or 2, 75 feet from the outlet, under full engine load and clear weather. Silencer shall be complete with handhole openings and necessary brackets for supporting purposes. Sizing of silencer shall be in accordance with engine and silencer manufacturer's recommendations. Flanged inlet and outlet connections shall be provided.

Octave Band Center Frequency Hz	Maximum Sound Level Decibels
63 and below	78
125	68
250	60
500	53
1,000	48
2,000	44
4,000	42
8,000	41

c. Expansion (flexible) joints: Provide sections of multiple corrugated stainless steel expansion joints with liners in the engine exhaust piping for each engine to absorb expansion strains and vibration in the piping. Flexible joints in exhaust piping shall be suitable for continuous operation at 200 degrees F above the normal exhaust gas temperature at 110 percent load. Air intake expansion joints shall be as specified for exhaust piping or may be reinforced rubber type suitable for the service. Joints shall be of the same size as pipe and provided with flanged connections. Air intake expansion joints may be for plain end pipe.

d. Air intake piping: Conform to manufacturer's recommendations for size, type, and connections.

e. Exhaust piping: Provide piping for each engine complete with necessary fittings, flanges, gaskets, bolts, and nuts. Pipe shall be steel conforming to ASTM A 53. Exhaust piping shall be Schedule 40 for 12 inch and smaller sizes and for larger sizes shall have wall thickness not less than 0.375 inch. Exhaust piping shall slope away from engine. Flanges shall be 150 pound slip-on forged steel welding flanges conforming to ASME B16.5, with material in accordance with ASTM A 181/A 181M, Grade I. Fittings shall be butt-welding conforming to ASTM A 234/A 234M, with wall thickness same as adjoining piping. Built-up miter welded fittings may be used. Fittings shall be of same material as pipe. Miter angles of each individual section shall not exceed 22.5 degrees total and not more than 11.25 degrees relative to pipe axis at any one cut. Gaskets for piping shall be of high temperature asbestos-free material suitable for the service. Bolting material for exhaust flanges shall be alloy-steel

bolt-studs conforming to ASTM A 193/A 193M, and alloy-steel nuts conforming to ASTM A 194/A 194M. Bolts shall be of sufficient length to obtain full bearing on nuts and shall project not more than two full threads beyond the nut.

2.5 GENERATORS AND EXCITATION AND VOLTAGE REGULATION SYSTEM

2.5.1 Generator

Provide 0.80 power factor, synchronous, ac, brushless-excited, revolving field, air-cooled, self-ventilated unit conforming to NEMA MG 1 and rated as specified in paragraph entitled "Equipment Rating and Capability." Enclosure frame shall be dripproof. Match generator speed to that of engine. Drive generator directly from engine crankshaft in a manner approved by both engine and generator manufacturers. Generator shall be capable of carrying at rated voltage and 0.8 power-factor, a load equal to net kW rating of the engine without exceeding temperature limits specified in NEMA MG 1 for standby duty. Winding insulation shall be Class F or H. An amortisseur winding shall be provided and generator and flywheel shall have sufficient flywheel effect to meet requirements of regulation specified. Generator field voltage shall be manufacturer's standard voltage. Prime power generator neutral shall be solidly grounded. Standby generator neutral shall be solidly grounded when 4-pole transfer switch is used and shall not be bonded to ground at the generator when 3-pole transfer switch is used. Ground generator enclosure at two opposite mounting legs.

2.5.2 Excitation and Voltage Regulation Systems

Comply with IEEE Std 421.1.

2.5.2.1 Exciter

Integral with generator; synchronous, rotating armature, rotating rectifier, brushless or permanent magnet brushless type. Mount rotating rectifier assembly in a manner to provide ready access for inspection and replacement of rectifier diodes. Semiconductor rectifiers shall have minimum factor of safety of 300 percent for peak inverse voltage, and forward current ratings for operating conditions, including 100 percent generator output at 40 degrees C ambient. Provide safety devices for protection of rectifiers against overload currents and voltages unless design provides this protection inherently. Acceptable ratio of exciter ceiling voltage to exciter nominal voltage shall be not less than three to two.

2.5.2.2 Voltage Regulator, IEEE Device 90

Provide a solid state voltage regulator that automatically controls the generator field current through action on the exciter, and provides immunity from SCR tracking. Voltage regulator shall enable manual adjustment of set output voltage, while set is operating, by potentiometer adjustment at generator control panel. Voltage regulator shall enable parallel operation with like sets. Provide cross connection of voltage regulators of sets to enable operation in parallel with minimal voltage drop.

a. Operation: Voltage regulator shall have characteristics and sensors which enable generator to operate alone or in parallel with other generators in isochronous load sharing mode and in

conjunction with common solid-state control to operate isochronously with proportional load sharing. Provide voltage transformers, when required, for voltage sensing and current transformer for crosscurrent compensation to operate in parallel with other generators in isochronous load sharing mode. Provide a contact to short out the current transformer when a generator is not connected to its output bus. Install instrument transformers and voltage regulator in the generator control panel along with a manual voltage setting control.

b. Regulation: Voltage regulator/excitation systems shall be capable of voltage regulation within plus or minus 2, 1, 0.5 percent from no-load to full-load. A 5 percent variation in frequency and effects of field heating shall not affect units regulation performance. System shall provide 300 percent rated generator current for at least 10 seconds to provide short-circuit current adequate to operate circuit breakers.

2.6 FUEL OIL SYSTEM

Conform to NFPA 30 and NFPA 37 and requirements herein.

2.6.1 Fuel Oil Day Tanks

Provide subbase-mounted tank with a minimum capacity of 8 hours of engine-generator set operation at full-rated load for each engine-generator set. Tank may be the standard design as provided by engine manufacturer or shall be constructed as specified in paragraph entitled "Tank Construction." Provide tank with a level gage and makeup control valve. Include connections of indicated sizes for inlet, outlet, overflow, vent, drain, and level controller and high and low level alarm switches.

2.6.1.1 Level Alarm Switches

Provide tank-top mounted or external float cage, single-pole, single-throw type designed for use on fuel oil tanks. Arrange high level alarm switches to close on rise of liquid level, and low level alarm switches to close on fall of liquid level. Mount float cage units with isolating and drain valves. Contacts shall be suitable for control battery voltage.

2.6.1.2 Tank Gages

Provide tank gages for fuel oil day tanks. Gages for fuel oil day tanks shall be buoyant force type, with dial indicator not less than 4 inches in size and arranged for side mounting. Each dial or scale shall be calibrated for its specific tank to read from empty to full, with intermediate points of 1/4, 1/2, and 3/4.

2.6.2 Fuel Oil Filter

Provide manufacturer's standard.

2.7 LUBRICATING OIL SYSTEM

2.7.1 Auxiliary Lubricating Oil Pumps

Where recommended by the engine manufacturer, provide one pump for each engine, each suitable for "before-and-after" lubricating and cooling service as required by the engine. Equip each pump with a bypass relief

valve.

2.7.2 Lubricating Oil Filtration

Provide each engine with a pressurized lubricating oil filtration system capable of filtering the full rate of oil flow from the oil pumps at maximum engine speed in accordance with standard practice of engine manufacturer. Provide means to ensure delivery of lubricating oil to vital wearing surfaces regardless of the condition of filters without removing engine from service. Filters shall provide means of automatically bypassing filter when filter becomes flow-restricting. When electric heaters are used, provide thermostatically controlled type suitable for the indicated electrical supply. Provide throwaway type filter elements as recommended by engine manufacturer.

2.7.3 Lubricating Oil Coolers

When recommended by engine manufacturer, provide coolers for each engine to maintain lubricating oil within temperature limits recommended by the engine manufacturer under all operating conditions. Cooling system and components shall be as specified by the engine manufacturer for use with the class of engine being provided, and cooling medium to be used. Provide engine jacket coolant from the radiator as cooling medium. Each thermostat in the oil cooling system shall be nonadjustable and factory set at the temperature recommended by the engine manufacturer.

2.7.4 Thermostatic Control Valves

When recommended and standard practice with the engine manufacturer for the proposed engine, provide a valve installed in the lubricating oil system for each engine to maintain a constant lubricating oil temperature from the engine. Valve shall be as specified in paragraph entitled "Thermostatic Control Valves." Valve shall be capable of passing total lubricating oil flow requirement of the engine as determined by engine manufacturer with a pressure drop across the valve not to exceed 5 psi.

2.8 COOLING SYSTEM

2.8.1 Jacket Coolant Pumps

Provide one pump for each engine driven from engine crankshaft or camshaft. Each pump shall have ample capacity to circulate required flow of coolant specified through the system to remove total heat rejected from the engine and, where provided by design, from lubricating oil and intercoolers. Heat shall be rejected to jacket coolant to maintain optimum jacket coolant temperature leaving and entering engine as recommended by the engine manufacturer.

2.8.2 Radiators

Provide one radiator unit for each engine-generator set. Provide engine subbase mounted radiators of forced draft type with horizontal or vertical air discharge as standard with engine manufacturer.

a. Design Conditions: Each radiator unit shall have ample capacity to remove not less than the total Btu per hour of heat rejected by its respective engine at 100 percent full-rated load to jacket coolant, to lubricating oil system, to air surrounding the engine on subbase-mounted radiator units and that necessary for

turbocharger intercooler. Radiator capacity shall be rated at optimum temperature of coolant leaving engine and intercooler as recommended by the engine manufacturer, with a dry bulb air temperature of 110 degrees F. Pressure drop through the radiator shall not exceed 6 psi when circulating maximum required coolant flow. Radiator air velocity shall be a maximum of 900 feet per minute. Coolant solution shall be a mixture of clean water and a commercial standard methoxy-propanol or ethylene glycol coolant providing protection to 0 degrees F. Mixture shall be to proportions recommended by the engine manufacturer to meet site conditions. Provide an antifreeze solution tester suitable for solution used.

b. Engine Subbase-Mounted Radiator Construction: Radiator fan shall direct air flow from the engine outward through the radiator. Fan may be driven directly from engine crankshaft through V-belt drive. Radiator shall have sufficient capacity to meet design conditions against a static restriction of 0.5 inch of water as may be imposed by louvers and ductwork. Cooling section shall have a tube and fin type core. Engine-driven fans shall be engine manufacturer's standard units, selected for quiet vibration-free operation. Provision shall be made for coolant expansion either by self-contained expansion tanks or separately mounted expansion tanks, as standard with manufacturer. Provide suitable guards for each fan and drive. Provide exhaust duct with flexible connections between radiator and wall louver. Ductwork shall conform to SMACNA DCS.

2.8.3 Thermostatic Control Valves

When recommended and standard with engine manufacturer for proposed engine, provide a valve installed in the jacket coolant system for each engine to maintain a constant jacket coolant temperature from the engine. Valve shall be as specified in paragraph entitled "Thermostatic Control Valves." Valve shall be capable of passing coolant flow, as determined by the engine manufacturer.

2.8.4 Starting Aids

Provide a factory-installed, electrically operated, jacket coolant heating system to ensure rapid starting. Thermostatically control heater at the temperature recommended by engine manufacturer. Connect power leads to a junction box which shall provide fusing and manual disconnection of the heater. Include necessary equipment, piping, controls, wiring, and accessories.

2.9 ELECTRIC STARTING SYSTEM

Provide a 24-volt dc starting battery installation for starting of each engine-generator set utilizing an electric cranking system. Electric cranking system shall be capable of rotating the engine at a speed sufficient for rapid starting in an ambient temperature of 20 degrees F. Signal for starting shall come from engine-generator set control system.

2.9.1 Cranking

Energize electric cranking system from negative polarity grounded starting batteries. Provide heavy-duty type cranking motors with capacity to crank the engine continuously to start the engine. Drive mechanism for engaging

starting motors with engine flywheel shall be designed to inherently engage and release without binding. When engine starts, starting gearing shall automatically disengage and starting motors shall shut down. Automatic cranking panel shall crank engine as specified under paragraph entitled "Engine Cranking Relay."

2.9.2 Starting Battery Installation

Provide lead acid industrial engine cranking batteries designed for diesel engine starting of sufficient size and capacity in a fully charged condition to crank engine for four consecutive cycles of 30 seconds cranking followed by 120 seconds rest. Provide battery racks or enclosures, properly ventilated for the batteries and charger. Provide necessary cabling.

2.9.3 Starting Battery Charger

Provide enclosed, automatic, dual-rate, solid-state, constant voltage type battery charger having ac voltage compensation, dc voltage regulation, and current limiting. Charger shall employ transistor-controlled magnetic amplifier circuits to provide continuous taper charging. Charger shall have two ranges, float and equalize, with 0 to 24 hour equalizer time, dc cranking relay, silicon diode full-wave rectifiers, automatic surge suppressors, dc ammeter, dc voltmeter, and fused inputs and outputs. Charger shall have continuous rated output of not less than 10 amperes and conform to UL 1236.

2.10 ENGINE-GENERATOR SET CONTROLS

Provide an engine-generator control panel mounted on each engine-generator set subbase and as indicated. Manufacturer's standard electronic control panels may be provided in lieu of those specified below if they accomplish the same functions.

2.10.1 Engine-Generator Control Panel

Provide an enclosed panel fabricated of not lighter than 14 gage sheet steel in compliance with NEMA 250, Type as indicated. Construct cabinet with angle iron framework, if required, for proper stiffness and support. Size cabinet to accommodate specified equipment when arranged in an orderly and approved manner. Factory-mount panel on engine unit subbase. Provide isolation mounting material between subbase and panel to isolate the panel from engine vibrations. Provide panel-mounted devices with nameplates of laminated black gloss-finished plastic with white engraved lettering. Provide connecting piping, tubing, and wiring installed in conduit where not otherwise enclosed.

2.10.1.1 Engine Control Panel

Provide devices of the type standard with the manufacturer utilizing minimum 2 inch nominal diameter gages. Provide instruments subject to rapid pressure surges with damping devices to give a steady reading. Provide the following panel-mounted devices as a minimum:

a. Engine Controls: Install engine controls on generator control panel.

b. Engine Instrumentation:

(1) Fuel oil pressure gage.

(2) Lube oil pressure gage.

(3) Coolant temperature gage.

(4) Elapsed time meter.

c. Engine Safety Circuit Devices: Provide the following devices to stop engine-generator set and to simultaneously open its main circuit breaker. Stop switch may be connected to this safety circuit when recommended by the manufacturer. Source of energy for engine safety circuit devices shall be the starting, control battery, separate from the starting circuit.

(1) Overcranking.

(2) Overspeed.

(3) Excessive coolant temperature.

(4) Dangerously low lubricating oil pressure.

2.10.1.2 Generator Control Panel

Install controls in engine-generator control panel. Provide generator controls and instrumentation as follows:

a. Generator controls

(1) Generator circuit breaker, IEEE Device 52.

(2) Voltage regulator and associated controls.

(3) Governor remote control switch.

b. Generator instrumentation and metering

(1) Voltmeter and control switch.

(2) Ammeter and control switch.

(3) Three current and three voltage (potential) transformers.

c. Engine starting and stopping controls and protective equipment

(1) Engine starting switch.

(2) Engine cranking relay.

(3) Engine shutdown relay.

(5) Automatic transfer and bypass isolation combination switch.

(6) Surge arrester and capacitor assembly

d. Local Alarm Panel: Provide manufacturer's standard local alarm panel suitable for operation on the control battery voltage. Provide with pre-shutdown and shutdown alarms in accordance with

NFPA 99. Provide panel with factory-installed annunciator having a noise level of not less than 95 decibels at 10 feet and provide with silencing switch. Provide the following alarms with pre-shutdown alarms only for temperature and pressure conditions and shutdown alarms for all conditions:

(1) High jacket coolant temperature

(2) High lubricating oil temperature

(3) Low lubricating oil pressure

(4) Low fuel oil pressure

(5) Engine shutdown due to overspeed

(6) Engine starting failure

(7) Other engine-generator set abnormal conditions as recommended by the manufacturer

2.10.2 Generator Control Panel Devices

2.10.2.1 Generator Circuit Breaker, IEEE Device 52

Provide circuit breaker having a solid-state tripping device with adjustable long-time and short-time tripping characteristics. Provide stored-energy closing mechanism for rapid and safe closing of circuit breaker against fault currents within the short-time rating of circuit breaker independent of operator's strength or effort in closing the handle. Size circuit breaker for the 100 percent full-load capacity of engine-generator set and provide lugs for indicated electrical connection.

a. Circuit Breaker Type:

(1) Molded-case, 100 percent rated

(a) NEMA AB 1 and UL 489

(2) Low-voltage Power Circuit Breakers

(a) IEEE C37.13 and ANSI C37.16

2.10.2.2 Instrument and Control Switches

Utilize rotary-enclosed, rear-mounted switches having positive means of maintaining contacts, which shall be silver-to-silver type, identifying escutcheon plates, and handle targets to indicate switch position. Utilize knurled handles for instrument switches, standard pistol grip handles for circuit breaker. Provide red and green indicating lights for circuit breaker control switches.

2.10.2.3 Indicating Lights

Provide front removable, low drain, push-to-test, indicating lights equipped with dropping resistors suitable for 120-vac service, as required and color caps as specified.

2.10.2.4 Instruments

Provide semiflush-mounted, rectangular, switchboard instruments with rear connecting terminals, ANSI C39.1. Construct with taut-band suspension movement and 250 degree scales in a nominal 4.5 inch square case. Design and calibrate for vertical or horizontal mounting, as required. Elapsed time meters shall totalize engine running time to 9999.9 hours.

2.10.2.5 Instrument Transformers

Provide indoor, dry-type conforming to IEEE C57.13. Coordinate mechanical and thermal ratings with circuit breakers and other apparatus in the switchboard. Provide voltage transformers as shown or as required of the nondrawout type with current-limiting primary fuses and secondary fuses.

2.10.2.6 Engine Starting Switch

Four-position rotary, enclosed rear mounting, maintained-position type. Switch positions shall be "Automatic," "Off," "Test," and "Manual" and connected to provide the following operation:

a. In "Automatic" position, engine-generator set shall start automatically in response to loss of voltage, as described in paragraph "Automatic Controls."

b. In "Off" position, engine-generator set starting circuits shall not function.

c. In "Test" position, engine may be started and brought up to speed, but engine-generator set cannot be put on line.

d. In "Manual" position, switch shall start and bring engine-generator set up to speed and then connect it to line.

2.10.2.7 Engine Cranking Relay

Provide to operate as follows:

a. When actuated, device shall close contacts to actuate engine starting system.

b. Should engine fail to start at once, cranking shall continue for 30 seconds (adjustable) after which a 120-second "off" period (adjustable) shall occur. Durations of cranking and "off" periods listed above may be modified in accordance with engine manufacturer's recommendations.

c. Repeat above described cranking cycle for four starting attempts.

d. If engine still fails to start, cranking device shall lock out further starting attempts until device is manually reset. When cranking relay locks out, an alarm light shall be energized on the panel and remain lighted until relay is manually reset.

2.10.2.8 Engine Shutdown Relay

Provide and actuate by engine protective devices as specified in paragraph "Engine Safety Circuit Devices." Shutdown relay shall disable engine starting circuits until manually reset. Provide reset pushbutton on

switchboard.

2.10.2.9 Surge Arrester and Capacitor Assemblies

Provide surge arrester and capacitor assemblies designed for use on a three-phase, four-wire solidly grounded system and designed for engine-generator set voltage level. Provide metal-oxide type surge arresters designed for a maximum 10-kiloampere discharge. Provide surge capacitors specifically designed for use with associated surge arrester. Provide capacitors for generators with built-in resistors and designed for rotating machine protection.

2.11 MISCELLANEOUS ENGINE SYSTEM REQUIREMENTS

2.11.1 Tank Construction

Construct tanks of not less than 3/16 inch steel plate with welded joints and necessary stiffeners on exterior of tank. Provide a braced structural steel framework support. Weld tank top tight and provide an access opening with dustproof, removable 24 inch cover.

2.11.2 Flange Connections

Where not otherwise indicated, provide piping connections in accordance with ASME B16.1 for 125 pound flanges.

2.11.3 Thermostatic Control Valves

Valves shall be modulating type utilizing self-contained thermostats without the use of external bulbs, and equipped with three-way valve action. Provide valves with one or more interchangeable thermostatic elements. Thermostat shall be nonadjustable and operating temperature shall be factory-set at temperature recommended by engine manufacturer. Provide valve designed to fail-safe, permitting flow through engine.

2.12 WIRE AND CABLE

Provide wire and cable required for a complete electrical system as shown. Comply with requirements specified in Section 26 20 00, "Interior Distribution System."

2.13 WEATHER RESISTANT ENCLOSURE

Provide a weather resistant enclosure for generator sets. Fabricate from zinc-coated phosphatized and shop primed 16 gage minimum sheet steel in accordance with manufacturer's standard design. Provide enclosure for engine, generator, control panel, excitation equipment, voltage regulator, engine safety control, and accessories. Enclosure shall have sufficient louvered openings to allow entrance of outside air for engine and generator cooling at full load. Louvered openings shall be designed to exclude driving rain and snow. Provide properly arranged and sized hinged panels in the enclosure to allow convenient access to engine, generator, and control equipment for maintenance and operation. Provide lockable, hinged panels with spring latches to hold panels closed securely and not allow panels to vibrate. Brace housing internally to prevent excessive vibration when generator set is in operation.

2.14 VIBRATION ISOLATION SYSTEM

The isolation system shall reduce the vibration transmitted to the adjacent floor slab to a maximum of 0.0015 inch total amplitude throughout the frequency range down to 65 CPS. The manufacturer shall certify that the vibration isolation system will reduce the vibration to the limits specified.

2.15 IDENTIFICATION OF EQUIPMENT

Each major component of equipment shall have the manufacturer's name, address, and model and serial number on a nameplate securely affixed in a conspicuous place; nameplate of the distributing agent will not be acceptable. Nameplates shall not be painted.

2.16 SOURCE QUALITY CONTROL

Perform and report on factory tests prior to shipment. Provide certified copies of manufacturer's test data and results. Notify Contracting Officer before performing tests. Contracting Officer or Contracting Officer's representative reserves the right to witness tests. Test procedures shall conform to ASME, IEEE, IEC, and ANSI Standards, and to SAE requirements on testing, as appropriate and applicable. Ensure that measuring and indicating devices are certified correct. Tests shall indicate satisfactory operation and attainment of guarantees and specified performance. When satisfactory, equipment tested will be given a tentative approval. Equipment shall not be shipped before approval of factory test reports for the following tests:

2.16.1 Engine-Generator Set Tests

Perform customary commercial factory tests on each engine-generator set, including, but not necessarily limited to, the following:

a. Perform hydrostatic test on engine water jackets and piping to ensure that water seals and water jackets are water tight. Test report shall indicate pressure at which test was made and the results.

b. Place engine-generator set in continuous operation without stoppage for a period of not less than 8 hours. Operate not less than one hour at each load point, that is 1/2, 3/4, and full load. When stoppage becomes necessary during this period, repeat the 8-hour run. Record the following data for sets at the start, at 15-minute intervals, and at end of each load run: exhaust temperatures; engine coolant temperatures; lubricating oil temperatures and pressures; and any other data of importance.

2.16.1.1 Generator Tests

Ensure that temperature tests on one generator's windings are performed by manufacturer of generator in manufacturer's own plant. Temperature tests shall be in accordance with IEEE Std 115 and IEC 34. Generator tests shall include insulation resistance and dielectric resistance. Prototype tests for generators that are physically and electrically identical to those provided under the Contract are acceptable. Calculations of subtransient reactance shall be included in the test report.

PART 3 EXECUTION

3.1 PREPARATION

Use cribbing and shoring as required to protect construction from moving-in damage. Protect flooring and finished surfaces with heavy planking. Obtain approval of methods and materials from the Contracting Officer or the Contracting Officer's authorized representative before moving equipment across shored floors.

3.2 INSTALLATION

Installation shall be in strict accordance with manufacturer's instructions. Provide labor, tools, equipment, and other necessities for erection and installation of equipment. After equipment has been installed, remove shoring and repair damage to floors and other parts of the building. Furnish the services of one or more Diesel-Generator representative or technicians, experienced in installation and operation of the type of systems being provided, to supervise the installation.

3.2.1 Installation of Engine-Generator Sets

Install engine-generator sets on a concrete foundation as indicated. Provide vibration isolators to isolate vibrations from engine-generator set to the foundation.

3.2.2 Equipment Supports and Installation

Provide devices to support equipment not supported on engine-generator structural steel subbase as required. Fabricate required supports of structural steel sections, plates or rods, and arrange to provide rigid and sturdy support. Provide connections and fasteners required between equipment supports and building structures.

3.2.3 Instruction of Operators

After equipment is ready to be placed in service, Contractor and equipment manufacturer's representative shall fully instruct plant operators in operation and maintenance of the equipment. Posted operating instructions for diesel engine-generator set shall be provided adjacent to the unit.

3.2.4 Piping

Piping connecting the engine and equipment mounted on engine-generator subbase shall be factory installed and shall conform to manufacturer's standards for set sizes involved. Piping extensions from engine-generator and subbase to remote cooling and fuel systems shall conform to ASME B31.9 and NFPA 30. Arrange piping to provide a workable arrangement, with convenient access to valves and specialty items. Maintain adequate clearance between runs of piping to permit access around adjacent pipe for dismantling, repair, and maintenance of valves. Piping shall be straight, plumb, and run direct as possible. Do not install piping over electrical equipment.

3.2.4.1 Shop Fabrication

Shop fabricate pipe to greatest extent possible. Plug ends of piping and openings prior to shipment to plant site.

3.2.4.2 Welding

Preparing, bending, cleaning, and welding of piping shall conform to ASME B31.9. Welds shall be visually examined and meet acceptance standards of ASME B31.9.

3.2.4.3 Field Cleaning

Before placing in position, clean inside of black steel pipe by rapping along its full length to loosen sand, mill scale, and other foreign matter. Pipe 2 inch and larger shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to apparatus, wash out interior of coolant piping with water. Blow out air and fuel lines with 80 to 100 psi dry air or nitrogen.

3.2.4.4 Pickled Piping

Clean steel fuel oil piping and pickle internally by chemical cleaning. Cleaning process shall remove grease, oil, dirt, mill scale, lacquer, and corrosion products. Clean piping either by circulating cleaning solution through completed piping systems or by soaking prefabricated piping sections in a tank of solution. Provide and remove after use pumps, temporary piping connections, tanks, and other equipment required to accomplish cleaning of piping. After cleaning, thoroughly flush, drain, and dry piping and take necessary precautions to prevent rerusting before pipe is used. While cleaning, remove or isolate instrumentation, valves, and equipment installed in piping which contain bronze or brass. Cleaning solution shall not come in contact with bronze or brass. Cleaning solution shall not be circulated through engine piping systems. Provide cleaning solution of the type recommended by engine manufacturer and chemical manufacturer for the specific purpose.

3.2.4.5 Provisions for Expansion

Provide for expansion of piping subject to temperature change by using suitable flexible piping connectors, expansion joints, bends, ball joints, offsets, and loops in a manner that will prohibit development of excessive stresses between anchor points or at equipment connections. Provide bends, loops, and offsets wherever practical to prevent overstressing of piping systems due to thermal expansion and to provide adequate flexibility. A piping system may be cold sprung by an amount no greater than 50 percent of the total linear expansion to alleviate end thrusts and moments. Method of cold springing shall be as approved.

3.2.4.6 Reducing Fittings

Provide for changes in pipe size except where taps are permitted. Use of bushings is prohibited. In horizontal mains containing liquids, provide eccentric reducers.

3.2.4.7 Unions or Flanges

Provide where necessary to permit easy connection of piping and apparatus. Provide unions on valves with screwed ends. In long lines inside buildings, place unions or flanges not farther apart than 100 feet, except in pipe lines of welded construction where unions or flanges shall be placed as indicated.

3.2.4.8 Valves

Install in positions accessible for operation and repair. Install stems preferably in a vertical position with handwheels or operators on top, or install in a horizontal position. Do not install handwheels on stop valves below the valve. Install globe valves with flow direction from below the disk.

3.2.4.9 Connections to Equipment

Make piping connections to equipment shown and provide reducers, unions, and valves to make a complete installation. Make connections to equipment with unions or flanges. Provide valves the same size as piping in which they are installed.

3.2.4.10 Joints

a. Flanged Joints: Face pipe flanges true to line and thoroughly clean before assembly. Gasket faces shall be free of burrs or bruises. Make up flanged joints prior to completing the last weld in connecting piping. Coat bolt threads with a mixture of equal parts of graphite and boiled linseed oil or with an approved commercial coating.

b. Screwed Joints: Provide graphite pipe-joint compound conforming to MIL-T-5544; apply to male threads only. Antiseize zinc compound conforming to MIL-T-22361 may be provided. Piping shall be free of fins and burrs. Ream pipe ends or file out to size of bore; remove chips.

3.2.4.11 Pipe Sleeves

Provide where pipes and tubing pass through masonry or concrete walls, floors, roofs, and partitions. Sleeves in outside walls above grade, in floor, or in roof slabs shall be steel pipe. Sleeves in floor slabs shall extend 3 inches above the finished floor. Firmly pack space between pipe or tubing and sleeve with oakum and calk on both ends of sleeve with elastic cement, except for sleeves in plant operating floors which shall be free of packing and elastic cement. Where piping passes through steel grating, band the opening with one by 1/8 inch steel edge bands welded to the grating bars.

3.2.4.12 Wall Pipes

Provide cast iron wall pipes for piping passing through underground exterior walls and install in a manner to ensure a watertight connection between the wall and casting. Provide wall pipes with flanged ends conforming to ASME B16.1, Class 125. Extend flanged ends beyond wall to permit bolting of flanges to connecting piping.

3.2.4.13 Excavation and Backfill

Perform necessary trenching and backfill for outside piping to be furnished and installed. Excavate bottom of trenches to grade, with bell holes provided at each joint. Bottom of each length of pipe shall bear firmly against undisturbed earth for full length of barrel. Rocks larger than 3 inches in diameter in soil beneath the pipe shall not come into physical contact with pipe. Make changes in grade or alignment with suitable fittings. After installing and testing outside piping backfill trenches.

Consolidate backfill by mechanical tamping in layers not exceeding 6 inches. Remove excess materials from trenches and deposit as directed by the Government. Restore trench areas to original condition.

3.2.4.14 Slope, Drainage, and Ventilating

Slope piping to permit complete drainage. Install drain valves at low points in piping. Drain valves shall be 1/2 inch gate valves for pipe lines smaller than 3 and 3/4 inch gate valves for lines 3 inches and larger, except where specific sizes are shown. Drain valves shall be of same class as piping drained. Install vent valves at high points in piping. Vent valves shall be 1/2 inch globe valves.

3.2.4.15 Flashing

Flashing and counterflashing for pipes and supports passing through exterior walls above ground and through roof shall conform to details as indicated.

3.2.4.16 Anchors, Guides, and Supports

Anchor and support piping in a manner such that expansion and contraction will take place in the desired direction. Prevent vibration by use of vibration dampers and prevent undue strains on equipment served. Hangers used for supporting piping 2 inches and larger shall be the type permitting adequate adjustment after erection while still supporting the load. Provide supports to adequately carry weight of lines and to maintain proper alignment. Provide inserts and sleeves for supports in concrete where necessary, and in new construction place inserts and sleeves before concrete is poured.

3.3 FIELD QUALITY CONTROL

Perform and report on field tests and trial operations, and conduct field inspections, except final field inspection. Provide labor, calibrated and approved test equipment, and incidentals required for tests. Contracting Officer will witness field tests and trial operations and will conduct final field inspections. Give Contracting Officer 14 days notice of dates and times scheduled for tests, trial operations, and inspections which require the presence of the Contracting Officer. Rectify deficiencies and retest work affected by such deficiencies.

3.3.1 Piping Tests

Test piping system after lines have been cleaned. Test piping systems at a pressure of 1.5 times the design working pressure, and in no case less than 100 psig. Hydrostatically test piping, except for air and fuel, using water not exceeding 100 degrees F. Test air and fuel lines with clean, dry air or nitrogen. For air lines operating at pressure greater than 100 psig, test at design working pressure. During testing, remove gages, traps, and other apparatus which may be damaged by the test pressure, or valve off before conducting tests. Install a calibrated test pressure gage in the system to observe loss in pressure. Brush joints in piping system tested with air with a soapy water solution to check for leaks. Maintain required test pressure for a sufficient length of time to enable inspection of joints and connections. Rectify defects which develop during testing, and retest piping systems until they show no defect or weakness and are tight.

3.3.2 Preliminary Operation

Align and adjust equipment to ensure proper operation as instructed by manufacturers of equipment. Lubricate equipment prior to operation in accordance with manufacturer's instructions. Upon approval by Contracting Officer or the Contracting Officer's authorized representative, operate engine-generator sets under supervision of supervising erector at varying loads throughout the load range for a sufficient time to demonstrate that operation is proper and that pressures and temperatures are normal and within specified limits. Operate engines for a period of time sufficient to ensure that units are ready to carry test loads specified in paragraph "Engine-Generator Set Acceptance Tests" without damage to engine parts. During this preliminary operation, check operation and ensure proper functioning of auxiliary equipment. Make necessary adjustments to equipment to place auxiliary equipment in operating condition.

3.3.3 Electrical Equipment and Materials Tests

Test procedures, inspections, and sampling shall be as specified and noted below:

a. Phase Relationship Tests: Check connections to equipment for proper phase relationship. During such check, disconnect devices which could be damaged by application of voltage or reversed phase sequence.

b. Control Panel Tests: Test and adjust meters and relays in accordance with applicable referenced specifications.

c. Insulation Resistance Tests: Test field installed cables.Minimum acceptable values of insulation resistance of circuits shall be as recommended by the manufacturer.

3.3.4 Engine-Generator Set Acceptance Tests

When installation is complete and in operating condition, notify the Contracting Officer in writing that engine-generator sets and auxiliary equipment are ready for final field tests. The Contracting Officer or Contracting Officer's authorized representative will witness final acceptance tests. Perform tests as necessary to make certain that equipment is functioning properly. Tests shall include the following:

a. A test to determine generating unit speed regulation under a gradual change from zero to full load.

b. A test to determine generating unit instantaneous speed change with 50 percent load on or off.

c. A test to ensure proper functioning of the overspeed trip.

d. An individual test of each alarm device.

e. A 6, An 8 -hour load test, 2 hours each at 50, 75, and 100, and 110 percent load at the highest ambient temperature in the area, to prove cooling system operation in the installed location.

Inspect auxiliary equipment including, but not limited to, pumps, fans, radiators, compressors, instruments, and special valves to ensure proper operation. Auxiliary equipment may be field tested at the option of the

Contracting Officer. Auxiliary equipment test shall be in accordance with the latest ASME and IEEE performance test codes, when applicable. When no code exists for equipment to be tested, perform tests as prescribed by the Contracting Officer. Use plant electrical system load for loading engine-generator set under test. Furnish and connect a suitable water, air, rheostat for loading engine-generator set under test. Check oil after tests for presence of metal particles and water. Provide and install temporary instrumentation, piping, and electrical wiring and make electrical connections required for engine-generator set tests.

3.3.4.1 Test Reruns

When specified performance is not met by these tests, make such adjustments and changes, as necessary, and conduct additional tests, as necessary, to further check performance of equipment.

3.3.4.2 Failure to Meet Requirements

In the event equipment fails to meet specified performance or fails to operate satisfactorily, the Government shall have the right to operate equipment until defects have been corrected. If engine-generator sets fail to meet the guaranteed efficiency, the Government reserves the right to assess compensatory damages against the Contractor as determined in paragraph entitled "Compensatory Damages on Performance" or to reject engine-generator sets. Equipment proved to be faulty or inadequate for service specified will be rejected, but the Government shall have the right to operate rejected equipment until such time as new equipment is provided by the Contractor to replace equipment rejected.

3.3.4.3 Manufacturer's Field Services

Furnish the services of one or more diesel-generator representative or technicians, experienced in installation and operation of the type of systems being provided, to supervise testing, adjustment of the system, and to instruct Government personnel.

-- End of Section --

SECTION 26 33 53.00 20

UNINTERRUPTIBLE POWER SUPPLY (UPS)

04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S1.4	(1983; R 2006) Specification for Sound Level Meters (ASA 47)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 173	(2001a; R 2007e1) Standard Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2007) National Electrical Safety Code
IEEE C57.110	(1998; R 2004) Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents
IEEE C62.41.1	(2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms
IEEE Std 450	(2002) Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2003) Acceptance Testing Specifications

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2000) Quality management systems-Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA PE 1	(2003; R 2003) Uninterruptible Power Systems -- Specification and Performance Verification

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition

UNDERWRITERS LABORATORIES (UL)

UL 1449	(2006) Surge Protective Devices
UL 1778	(2005; Rev thru Jul 2006) Uninterruptible Power Systems

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

UPS Drawings

UPS Installation

SD-03 Product Data

UPS Module

Submittal shall include manufacturer's information for each component, device, and accessory provided with the transformer.

Factory Testing

UPS System

UPS Spare Parts

SD-06 Test Reports

Work Plan

Factory Test Plan

Performance Test Plan

Factory Tests

Performance Tests Report

Factory Tests Report

SD-09 Manufacturer's Field Reports

Initial Inspection and Tests

Performance Tests

SD-10 Operation and Maintenance Data

UPS Operation and Maintenance, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Installation

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Normal Operation

The UPS module rectifier/charger shall convert the incoming ac input power to dc power for the inverter and for float charging the battery. The inverter shall supply ac power to the critical load continuously. Inverter output shall be synchronized with the bypass ac power source, provided that the bypass ac power source is within the specified voltage and frequency range.

1.5.2 Emergency Operation (Loss or deviation of AC Input Power)

Whenever the ac input power source deviates from the specified tolerances or fails completely, the inverter shall draw its power from the battery system and shall supply AC power to the critical load without any interruption or switching. The battery shall continue to supply power to the inverter for the specified protection time or until return of ac input source. At the same time, an alarm shall sound to alert operating personnel and a trouble signal shall be sent over the communication network, allowing startup of a secondary power source or orderly shutdown of the critical load.

1.5.3 Return of AC Input Power Source

When stable ac input power source returns the rectifier/charger shall resume operation and shall simultaneously supply the inverter with dc power and recharge the battery. This shall be an automatic function and shall cause no disturbance to the critical load.

1.5.4 Failure of AC Input Power to Return

Should the ac input power fail to return before the battery voltage reaches the discharge limit, the UPS system shall disconnect from the critical load to safeguard the battery.

1.5.5 Transfer to Bypass AC Power Source

When the UPS controller senses an overload or degradation of the inverter output, the bypass switch shall automatically transfer the critical load from the inverter output to the bypass ac power source without an interruption of power. If the bypass ac power source is outside of specified tolerance limits, the UPS and the critical load shall shut down.

1.5.6 Retransfer to Inverter

The static bypass switch shall be capable of automatically retransferring the load back to the inverter output after the inverter output has returned to normal conditions. Retransfer shall only occur if the two sources are synchronized.

1.5.7 UPS Bypass Maintenance

Manual closure of the maintenance bypass switch shall transfer the critical load from the inverter output to the bypass ac power source without disturbing the critical load bus. UPS module shall be capable of manual return to normal operation after completion of maintenance.

1.5.8 Battery Maintenance

The battery protective device shall provide the means of disconnecting the battery from the rectifier/charger and inverter for maintenance. The UPS module shall continue to function and meet the performance criteria specified except for the battery back-up time function.

1.6 QUALITY ASSURANCE

The manufacturer shall have a documented quality assurance program including:

a. Inspections of incoming parts, modular assemblies and final product.

b. Final test procedure for the product including proof of performance specifications.

c. On-site test procedure shall include an inspection of controls and indicators after installation of the equipment.

d. ISO 9001 quality certification.

1.6.1 UPS Drawings

Detail drawings consisting of a complete list of equipment and materials, manufacturer's descriptive and technical literature, battery sizing calculations per IEEE Std 485, installation instructions, single-line diagrams, ladder-type schematic diagrams, elevations, layout drawings, and details required to demonstrate that the system has been coordinated and will function properly as a unit.

1.6.2 UPS Installation

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.3 Work Plan

Submit 6 copies of schedules of dates for factory tests, installation, field tests, and operator training for the UPS system. Furnish a list of instrumentation equipment for factory and field test reports.

1.6.4 Factory Test Plan

Submit 6 copies of factory test plans and procedures at least 21 calendar days prior to the tests being conducted. Provide detailed description of test procedures, including test equipment and setups, to be used to ensure the UPS meets the performance specification and explain the test methods to be used. As a minimum, the test procedures shall include the test required under the paragraph entitled "Factory Testing."

1.6.5 Performance Test Plan

Submit 6 copies of test plans and procedures at least 15 calendar days prior to the start of field tests. Provide detailed description and dates and times scheduled for performance of tests, and detailed description of test procedures, including test equipment (list make and model and provide functional description of the test instruments and accessories) and setups of the tests to be conducted to ensure the UPS meets the performance specification. Explain the test methods to be used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Performance Tests."

1.6.6 Factory Tests Report

Submit 6 copies of factory test report within 45 calendar days after completion of tests. Receive approval of test prior to shipping unit. Factory test reports shall be signed by an official authorized to certify on behalf of the UPS manufacturer of that the system meets specified requirements in accordance with the requirements set forth in paragraph entitled "Factory Testing". Test reports in shall be in booklet form tabulating factory tests and measurements performed, upon completion and testing of the installed system. Reports shall state the Contractor's name

and address, the name of the project and location, and list the specific requirements which are being certified.

1.6.7 Performance Tests Report

Submit report of test results as specified by paragraph entitled "Performance Tests" within 15 calendar days after completion of tests. Field test reports shall be signed by an official authorized to certify on behalf of the UPS manufacturer that the system meets specified requirements in accordance with the requirements set forth in paragraph entitled "Performance Tests". Test reports in shall be in booklet form tabulating factory tests and measurements performed, upon completion and testing of the installed system. Reports shall state the Contractor's name and address, the name of the project and location, and list the specific requirements which are being certified.

1.6.8 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.8.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.6.8.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.6.9 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. Equipment shall be supported by a service organization that is, in the opinion of the

Contracting Officer, reasonably convenient to the site.

1.6.9.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.9.2 Material and Equipment Manufacturing Date

Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Equipment placed in storage shall be protected from humidity and temperature variations, moisture, water intrusion, dirt, dust, or other contaminants. In harsh environments where temperatures exceed non-operational parameters established within this specification, the equipment storage facility shall be environmentally controlled to ensure temperature parameters are within equipment specification. Documentation of same shall be provided to the Government when storage is implemented.

1.8 PROJECT/SITE CONDITIONS

1.8.1 Environmental Conditions

The UPS and battery system shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage or degradation of operating characteristics.

a. Operating altitude: Sea level to 3,300 ft. (Systems applied at higher altitudes shall be derated in accordance with the manufacturer's instructions).

b. Non-operating altitude: Sea level to 36,000 ft.

c. Operating ambient temperature range: 32 to 104 degrees F. Range for batteries is 50 to 86 degrees F.

d. Non-operating and storage ambient temperature range: Minus 4 to plus 122 degrees F.

e. Operating relative humidity: 0 to 95 percent, without condensation.

1.8.2 Sound Pressure Levels

Sound pressure levels produced by the UPS, when operating under full rated load, at a distance of 5 feet, 39 inches in any direction from the perimeter of the unit, shall not exceed 75, 65 dB as measured on the A scale of a Type 1 sound level meter at slow response conforming to ASA S1.4.

1.8.3 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.9 SPECIAL TOOLS

Provide one set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

1.10 OPERATION AND MAINTENANCE MANUALS

1.10.1 Additions to UPS Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the followings on the actual UPS system provided:

a. An outline drawing, front, top, and side views.

b. Prices for spare parts and supply list.

c. Routine and field acceptance test reports.

d. Date of Purchase.

e. Corrective maintenance procedures.

f. Test measurement levels with specific test points.

1.10.2 Spare Parts

Furnish the following spare parts, of the same material and workmanship, meeting the same requirements, and interchangeable with the corresponding original parts.

a. Fuses: Two of each type and rating.

b. Circuit boards: One circuit board for each critical circuit.

c. Air Filters: One set of filters.

1.11 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 UPS SYSTEM DESCRIPTION

The UPS system shall conform to UL 1778 and shall consist of UPS module, battery system, battery protective device, static bypass transfer switch, controls and monitoring. Input ac power shall be connected to the normal source ac input of the UPS module. Alternate power source shall be connected to bypass/maintenance bypass. The battery shall be connected to the dc input of the UPS module through the battery protective device. The ac output of the UPS system shall be connected to the critical loads.

2.1.1 Semiconductor Fusing

Power semiconductors shall be fused with fast-acting fuses to prevent cascaded or sequential semiconductor failures. Indicator lamp or display

panel denoting blown fuse conditions shall be readily observable by the operator without removing panels or opening cabinet doors.

2.1.2 Control Power

Provide dual control power supplies. Control power shall be derived from two sources, input and output, with automatic selective control. The control power circuit shall have suitable protection, appropriately marked and located in the immediate vicinity of the input protective device.

2.1.3 EMI/RFI Protection

The components and the system shall be designed to minimize the emission of electromagnetic waves that may cause interference with other equipment.

2.1.4 Internal Wiring

Wiring practices, materials, and coding shall be in accordance with the requirements of NFPA 70, OSHA, and other applicable standards. Wire runs shall be protected in a manner which separates power and control wiring. Control wiring shall be minimum No. 16 AWG extra-flexible stranded copper. Logic-circuit wiring may be smaller. Ribbon cables shall be minimum No. 22 AWG. Control wiring shall have permanently attached wire numbers.

2.1.5 Internal Assembly

The printed circuit board (PCB) subassemblies shall be mounted in pull-out and/or swing-out trays where feasible. Cable connections to the trays shall be sufficiently long to allow easy access to all components. Where not feasible to mount PCB subassemblies in pull-out or swing-out trays, they shall be firmly mounted inside the enclosure. Every PCB subassembly shall be monitored. Self-test and diagnostic circuitry shall be included in the logic circuits such that a fault can be isolated down to the PCB subassembly level.

2.1.6 Cabinets

UPS system shall be installed in cabinets of heavy-duty structure meeting the NEMA PE 1 standards for floor mounting. UPS module cabinet shall be structurally adequate for forklift handling or lifting. Removable lifting eyes shall be provided on top of each cabinet. UPS module cabinet shall have hinged and lockable doors on the front only, with assemblies and components accessible from the front. Doors shall be key lockable. Operating controls shall be located outside the locked doors. Input, output, and battery cables shall be installed through the top or bottom of the cabinet.

2.1.6.1 Cabinet Finish

Equipment cabinet shall be cleaned, primed and painted in the manufacturer's standard colors, in accordance with accepted industry standards. Cabinets shall be labeled in accordance with NFPA 70 for arc flash hazard with warning sign reading: "Warning-Potential Arc Flash Hazard. Appropriate PPE and Tools Required when working on this equipment" or similar wording.

2.1.6.2 Live Parts (300 Volts and Above)

Live parts (300 volts and above) that are exposed when front access doors

are open shall be adequately protected or covered to minimize the chance of accidental contact.

2.1.6.3 Drawout Assemblies

Drawout assemblies weighing 50 lbs or more shall be provided with a means of lifting, either an overhead device or a hoisting device.

2.1.7 Safety

UPS shall be equipped with instruction plates including warnings and cautions, suitably located, and describing any special or important procedures to be followed in operating and servicing the equipment. The control panel display shall also provide warning messages prior to performing a critical function.

2.1.8 UPS System Load Profile

The UPS system shall be compatible with the load characteristics defined in the LOAD PROFILE below and load configuration. Compensation for UPS/load interaction problems resulting from nonlinear loads or transformer and motor inrush shall be provided.

LOAD PROFILE

Type of load: data processing equipment, main frame, and chilled water pump as indicated on shop drawings.
Size of load: kVA, kW, horsepower, voltage, and amperage as indicated on shop drawings.
Switching pattern: unswitched, cycled daily, cycled hourly, operated by thermostat, building management system control as indicted on shop drawings.
Transient characteristics: inrush current magnitude of times steady state rms current for duration of cycle; range of power factor variation as indicated on shop drawings, lagging, leading; voltage dip as indicated.
Steady-state characteristics: As indicated on shop drawings. 0.8 lagging, 0.9 lagging, 1.0 power factor as indicated.
Special factors: As indicated on shop drawings. harmonic characteristics - Total Harmonic Distortion as indicated high elevation, nonstandard input and output voltages as indicated.

2.2 UPS SYSTEM RATINGS

Unless stated otherwise, the parameters listed are under full output load at 0.8, 0.9 power factor, with batteries fully charged and floating on the dc bus and with nominal input voltage.

2.2.1 System Capacity

As indicated on shop drawings.

2.2.2 Battery Capacity

Discharge time to end voltage: 15 minutes, at 77 degrees F as indicated on shop drawings. End voltage at full discharge shall be 1.67 volts per cell. Battery shall be capable of delivering 150 percent of full rated UPS load at initial start-up.

2.2.3 Static Switch

Amperes symmetrical interrupting capacity, as indicated on shop drawings.

2.2.4 Module Bus Bracing

Braced for amperes symmetrical interrupting capacity, as indicated on shop drawings.

2.2.5 AC Input

a. Voltage 208, 240, 480 volts line-to-line.

b. Number of phases: 3-phase, 3, 4-wire, plus ground.

c. Voltage Range: Plus 10 percent, minus 20 percent, without affecting battery float voltage or output voltage.

d. Frequency: 50, 60 Hz, plus or minus 5 percent.

e. Power walk-in: 20 percent to 100 percent over 10 to 20 seconds.

f. Total harmonic current distortion (THD) reflected into the primary line: 5, 10 percent maximum.

g. Transformer sub-cycle inrush: 4 to 8 times full load rating.

h. Input surge protection: per IEEE C62.41.1 and IEEE C62.41.2.

i. Input power factor: Lagging from 1-100 percent load.

2.2.6 AC Output

a. Voltage 208, 240, 480 volts line-to-line, 120, 277 volts line-to-neutral.

b. Number of phases: 3-phase, 4-wire, plus ground.

c. Voltage regulation:

(1) Balanced load: Plus or minus 1.0 percent.

(2) 50 percent load imbalance, phase-to-phase: Plus or minus 2 percent.

(3) No-load voltage modulation: Plus or minus 1 percent.

(4) Voltage drift: Plus or minus 1 percent over any 30 day interval (or length of test) at stated ambient conditions.

d. Voltage adjustment: Plus or minus 5 percent manually.

e. Frequency: 50, 60 Hz.

f. Frequency regulation: Plus or minus 0.1 percent.

g. Frequency drift: Plus or minus 0.1 percent over any 24 hour interval (or length of test) at stated ambient conditions when on internal oscillator.

h. Harmonic content (RMS voltage): Voltage THD shall be a maximum of 2 percent with 100 percent linear load and 5 percent with 100 percent nonlinear load and a crest factor of less than 3 to 1.

i. Load power factor operating range: 1.0 to 0.8 lagging.

j. Phase displacement:

(1) Balanced load: Plus or minus 1 degree of bypass input.

(2) 50 percent load imbalance phase-to-phase: Plus or minus 3 degrees of bypass input.

k. Wave-form deviation factor: 5 percent at no load.

l. Overload capability (at full voltage) (excluding battery):

(1) 125 percent load for 10 minutes.

(2) 150 percent load for 60 seconds.

(3) 300 percent load for one cycle after which it shall be current limited to 150 percent until fault is cleared or UPS goes to bypass.

2.2.7 Transient Response

2.2.7.1 Voltage Transients

a. 100 percent load step: Plus or minus 5 percent.

b. Loss or return of ac input: Plus or minus 1 percent.

c. Automatic transfer of load from UPS to bypass: Plus or minus 4 percent.

d. Manual retransfer of load from bypass to UPS: Plus or minus 4 percent.

e. Response time: Recovery to 99 percent steady-state condition within 20 milliseconds after any of the above transients.

2.2.7.2 Frequency

a. Transients: Plus or minus 0.6 Hz maximum.

b. Slew Rate: 1.0 Hz maximum per second.

2.2.8 Efficiency

a. Minimum Efficiency: 90 percent at full load kW and 90 percent at 50 percent load.

2.3 UPS MODULE

2.3.1 General Description

UPS module shall consist of a rectifier/charger unit and a 3-phase inverter unit with their associated transformers, synchronizing equipment,

protective devices, surge suppression, input isolation transformer, and accessories as required for operation.

2.3.1.1 Interchangeability

The subassemblies in one UPS module shall be interchangeable with the corresponding modules within the same UPS, and from one UPS system to another of identical systems.

2.3.2 Rectifier/Charger Unit

Rectifier/charger unit shall be solid state and shall provide regulated direct current to the dc bus, supplying power to the inverter and charging the battery plant.

2.3.2.1 Input Protective Device

Rectifier/charger unit shall be provided with an input protective device. The protective device shall be sized to accept simultaneously the full-rated load and the battery recharge current. The protective device shall be capable of shunt tripping and shall have amperes symmetrical interrupting rating as indicated on shop drawings. The protective device shall have
provision for locking in the "off" position.

2.3.2.2 Surge Protection

A surge suppression device shall be installed at the UPS input to protect against lightning and switching surges. Internal components shall be protected from surges that enter at each ac input connection including main input, static bypass transfer switch, and maintenance bypass/isolation switch. Surge suppressors shall protect internal components according to IEEE C62.41.1 and IEEE C62.41.2, Category B. Surge suppressors shall be UL 1449 approved to fail in "safe" mode.

2.3.2.3 Input Isolation Transformer

A dry-type, isolated-winding power transformer shall be used for the rectifier unit. The transformer's hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation material when operating at full load. The transformer insulation shall be Class H, 150 degrees C rise. Transformer connections shall be accessible from the front. Transformer cabinet, if required, shall match the UPS cabinet and attach to it.

2.3.2.4 Power Walk-In

Rectifier/charger unit shall be protected by a power walk-in feature such that when ac power is returned to the ac input bus, the total initial power requirement will not exceed 20 percent of the rated full load current. This demand shall increase gradually to 100 percent of the rated full load current plus the battery charging current over the specified time interval.

2.3.2.5 Sizing

Rectifier/charger unit shall be sized for the following two simultaneous operating conditions:

a. Supplying the full rated load current to the inverter.

b. Recharging a fully-discharged battery to 95 percent of rated ampere-hour capacity within ten times the discharge time after normal ac power is restored.

2.3.2.6 Battery Charging Current

a. Primary current limiting: Battery-charging current shall be voltage regulated and current limited. The battery-charging current limit shall be separately adjustable from 2 percent to 25 percent of the maximum discharge current. After the battery is recharged, the rectifier/charger unit shall maintain the battery at full float charge until the next operation under input power failure. Battery charger shall be capable of providing equalizing charge to the battery.

b. Second step current limiting: The rectifier/charger unit shall also have a second-step battery current limit. This second-step current limit shall sense actual battery current and reduce the input power demand for battery recharging to 50 percent (adjustable from 30 percent to 70 percent) of the normal rate without affecting the system's ability to supply full-rated power to the connected load. The second-step current-limit circuit shall be activated by a dry contact signal from the generator set controls and shall prevent normal rate battery recharging until utility power is restored.

2.3.2.7 DC Ripple

Rectifier/charger unit shall minimize ripple current and voltage supplied to the battery; the ripple current into the battery shall not exceed 3 percent RMS of the inverter input rated current; the ripple voltage into the battery shall not exceed 2 percent RMS of the float voltage.

2.3.2.8 DC Voltage Adjustment

Rectifier/charger unit shall have manual means for adjusting dc voltage for battery equalization, to provide voltage within plus 10 percent of nominal float voltage.

2.3.2.9 Battery Isolation Protective Device

Module shall have a dc protective device to isolate the module from the battery system. The protective device size and interrupting rating shall be as required by system capacity and shall incorporate a shunt trip as required by circuit design. The protective device shall have provision for locking in the "off" position.

2.3.3 Inverter Unit

Inverter unit shall be a solid-state device deriving its power from the dc bus (rectifier or battery source) and providing ac power within specified limits to the critical load. Inverter shall utilize microprocessor controlled solid state Pulse Width Modulation (PWM) controlled IGBT power transistor technology to shape the ac output.

2.3.3.1 Output Overload

The inverter shall be able to sustain an overload as specified across its output terminals. The inverter shall not shut off, but shall continue to operate within rated parameters, with inverse-time overload shutdown

protection. If the overload condition persists beyond the rated parameters of the inverter, the inverter shall current limit, load shall be transferred to the bypass source, and the inverter shall disconnect automatically from the critical load bus.

If the bypass source is not available and the overload/fault condition continues, the inverter shall current limit for a limited time as determined by the manufacturer and shall shut down to protect the internal components.

2.3.3.2 Output Frequency Control

The inverter shall normally operate in phase-lock and synchronism with the bypass source. When the bypass source frequency deviates by more than ±0.5 Hz, the internal frequency oscillator shall automatically take control and become the new frequency reference. Upon restoration of the bypass source within the required tolerance, the inverter shall synchronize back with that source at a slew rate not exceeding the specified rate. The oscillator shall be temperature compensated and shall be manually adjustable.

2.3.3.3 Output Protective Device

The output protective device shall be capable of shunt tripping or opening on an applied control signal and shall have the proper frame size and trip rating to supply overload current as specified. External output protective device shall have provision for locking in the "off" position. The inverter output protective device shall work in conjunction with the bypass protective device for both manual and automatic load transfers to and from bypass power.

2.3.3.4 Output Transformer

The inverter output transformer shall be similar to the input transformer and shall be capable of handling up to K-13 nonlinear loads as described in IEEE C57.110.

2.3.4 External Protection

UPS module shall have built-in self-protection against undervoltage, overvoltage, overcurrent and surges introduced on the ac input source and/or the bypass source. The UPS shall also have built-in self-protection against overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching, or circuit breaker operation in the critical load distribution system.

2.3.5 Internal Protection

UPS module shall be self-protected against overcurrent, sudden changes in output load and short circuits at the output terminals. UPS module shall be provided with output reverse power detection which shall cause the module to be disconnected from the critical load bus when output reverse power is present. UPS module shall have built-in protection against permanent damage to itself and the connected load for predictable types of failure within itself and the connected load. At the end of battery discharge limit, the module shall shut down without damage to internal components.

2.4 STATIC BYPASS TRANSFER CIRCUIT

A static bypass transfer circuit shall be provided as an integral part of

the UPS and shall consist of a static switch, made up of two reverse-paralleled SCRs (silicon-controlled rectifiers) per phase conductor, and a bypass protective device or bypass switch, made up of a contactor or motor operated circuit breaker. The bypass protective device shall be in parallel with the static switch. The inverter output protective device shall disconnect and isolate the inverter from the bypass transfer circuit.

The control logic shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions and provides an uninterrupted transfer of the load to the bypass ac power source, without exceeding the transient limits specified herein, when a malfunction occurs in the UPS or when an external overload condition occurs. The power section of the static bypass transfer circuit shall be provided as a plug-in type assembly to facilitate maintenance. The static bypass transfer circuit shall be used to connect the input bypass ac power source to the critical load when required, and shall have the following features:

2.4.1 Uninterrupted Transfer

The static bypass transfer switch shall automatically cause the bypass ac power source to assume the critical load without interruption when the bypass control logic senses one of the following conditions and the UPS inverter output is synchronized to the bypass ac power source:

a. Inverter overload exceeds unit's rating.

b. Battery protection period is expired and bypass is available.

c. System failure.

d. Inverter output undervoltage or overvoltage.

2.4.2 Interrupted Transfer

If an overload occurs and the UPS inverter output is not synchronized to the bypass ac power source, the UPS inverter output shall current-limit for 200 milliseconds minimum. The inverter shall then turn off and an interrupted transfer to the bypass ac power source shall be made.

If the bypass ac power source is beyond the conditions stated below, an interrupted transfer shall be made upon detection of a fault condition:

a. Bypass voltage greater than plus or minus 10 percent from the UPS rated output voltage.

b. Bypass frequency greater than plus or minus 0.5 Hz from the UPS rated output frequency.

c. Phase differential of ac bypass voltage to UPS output voltage greater than plus or minus 3 degrees.

2.4.3 Manual Transfer

It shall be possible to make a manually-initiated static transfer from the system status and control panel. The transfer shall be make-before-break utilizing the bypass switch.

2.4.4 Automatic Uninterrupted Forward Transfer

The static bypass transfer switch shall automatically forward transfer, without interruption after the UPS inverter is turned "on", or after an instantaneous overload-induced reverse transfer has occurred and the load current has returned to less than the unit's 100 percent rating.

2.4.5 Forced Transfer

The control logic circuitry shall provide the means of making a forced or reverse transfer of the static bypass transfer circuit on an interrupted basis. Minimum interruption shall be 200 milliseconds when the UPS inverter is not synchronized to the bypass ac power source.

2.4.6 Overload Ratings

The static bypass transfer switch shall withstand the following overload conditions:

a. 1000 percent of UPS output rating for one cycle.

b. 150 percent of UPS output rating for one minute, 30 seconds.

c. 125 percent of UPS output rating for 10 minutes.

2.4.7 Static Switch Disconnect

A static switch disconnect shall be incorporated to isolate the static bypass transfer switch assembly so it can be removed for servicing. The switch shall be equipped with auxiliary contacts.

2.5 MAINTENANCE BYPASS SWITCH

2.5.1 General

A maintenance bypass switch shall be provided as an integral part of the UPS and located within the UPS module or in a matching cabinet adjacent to the UPS cabinet, in a wall-mounted enclosure, in a free-standing floor-mounted enclosure. The maintenance bypass switch shall provide the capability to continuously support the critical load from the bypass AC power source while the UPS is isolated for maintenance. The maintenance bypass switch shall be housed in an isolated compartment inside the UPS cabinet, in a separate cabinet or enclosure, in such a way that service personnel will not be exposed to electrically live parts while maintaining the equipment. Switch shall contain a maintenance bypass protective device and a module isolation protective device.

2.5.2 Load Transfer

The maintenance bypass switch shall provide the capability of transferring the critical load from the UPS static bypass transfer switch to maintenance bypass and then back to the UPS static bypass transfer switch with no interruption to the critical load.

2.5.3 Load Bank Protection Device

A load bank protective device shall be provided to allow the UPS system to be tested using a portable load bank. The load bank protective device shall be connected on the line side of the maintenance bypass switch isolation

protective device.

2.5.4 Voltage Matching, Isolation Transformer

The maintenance bypass cabinet shall contain a voltage matching transformer, an isolation transformer as required to match the output voltage requirements.

2.6 MODULE CONTROL PANEL

The UPS module shall be provided with a control/indicator display panel. The display panel shall be on the front of the UPS module. Controls, meters, alarms and indicators for operation of the UPS module shall be on this panel. The display panel shall be menu driven for browsing all the screens.

2.6.1 Module Meters

2.6.1.1 Monitored Functions

The following functions shall be monitored and displayed:

a. Input voltage, phase-to-phase (all three phases).

b. Input current, all three phases.

c. Input frequency.

d. Battery voltage.

e. Battery current (charge/discharge).

f. Output voltage, phase-to-phase and phase-to-neutral (all three phases).

g. Output current, all three phases.

h. Output frequency.

i. Output kilowatts.

j. Elapsed time meter to indicate hours of operation, 6 digits.

k. Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).

l. Output kilovars.

m. Output kilowatt hours, with 15-minute demand attachment.

n. Battery temperature.

o. Output Percentage load.

p. Remaining battery time.

2.6.1.2 Meter Construction

The display panel shall display alphanumeric parameters based on true RMS

metering with 1 percent accuracy (minimum 4 significant digits).

2.6.2 Module Controls

Module shall have the following controls:

a. Lamp test/reset pushbutton.

b. Alarm test/reset pushbutton.

c. Module input protective device trip pushbutton, with guard.

d. Module output protective device trip pushbutton, with guard.

e. Battery protective device trip pushbutton, with guard.

f. Emergency off pushbutton, with guard.

g. DC voltage adjustment potentiometer, with locking guard.

h. Control power off switch.

i. UPS/bypass transfer selector switch.

j. Static bypass transfer switch enable/disable selector switch.

2.6.3 Module Alarm Indicators

Module shall have indicators for the following alarm items. Any one of these conditions shall turn on an audible alarm and the appropriate summary indicator. Each new alarm shall register without affecting any previous alarm.

a. Input ac power source failure.

b. Input protective device open.

c. Input power out of tolerance.

d. Overload.

e. Overload shutdown.

f. DC overvoltage/shutdown.

g. DC ground fault.

h. Low battery.

i. Battery discharged.

j. Battery protective device open.

k. Blower fan failure.

l. Input transformer overtemperature.

m. Low battery shutdown.

n. UPS on battery.

o. Equipment overtemperature.

p. Fuse blown (with indication where).

q. Control power failure.

r. Charger off/problem.

s. Inverter fault/off.

t. Emergency power off.

u. External shutdown (remote EPO activated).

v. Critical load on static bypass.

w. Static bypass transfer switch disabled/failure.

x. Inverter output overvoltage.

y. Inverter output undervoltage.

z. Inverter output overfrequency.

aa. Inverter output underfrequency.

bb. Bypass source voltage outside limits.

cc. Bypass frequency out of range.

dd. Bypass source to inverter out of synchronization.

ee. Overtemperature shutdown.

ff. Hardware shutdown.

2.6.4 Module Emergency OFF Button

Pressing the emergency off button shall cause the module to be disconnected from the system, via its input protective device, output protective device, and battery protective device. The button shall include a protective cover to prevent unintentional activation.

2.7 SELF-DIAGNOSTIC CIRCUITS

The control logic shall include status indicators for trouble-shooting the control circuits. These indicators shall be mounted on the circuit card edge or face such that they will be visible without repositioning the card, and shall be labeled with the function name.

2.8 REMOTE MONITORING PANEL

A remote monitoring panel shall be provided to monitor system status. The panel shall be designed for wall mounting near the critical load.

2.8.1 Indicators

Minimum display shall include the following indicators:

a. Load on UPS.

b. Load on battery.

c. Load on bypass.

d. Low battery.

e. Summary alarm.

f. New alarm (to alert the operator that a second summary alarm condition has occurred).

2.8.2 Audible Alarm

Any single indicator shall also turn on the audible alarm. An audible alarm test/reset button and lamp test/reset button shall be included. This reset button shall not affect nor reset the alarm on the module.

2.9 COMMUNICATIONS AND DATA ACQUISITION

An RS 232, RS 485 communications and data acquisition port shall be provided. This port shall allow the system parameters, status, alarm indication and control panel functions specified to be remotely monitored and controlled.

Additionally, a second communication port shall be provided for use with the following:

a. A set of six, eight Form C remote alarm contacts rated at 120V, 0.5A, shall be provided for remote alarm monitoring.

b. Auto-dial modem communication shall be provided to communicate with a remote modem in case an alarm function is active.

c. A SNMP (Simple Network Management Protocol) adapter shall be provided to communicate UPS monitoring via a network or direct connection to a PC.

d. A standard Web Browser adapter shall be provided to remotely view and monitor UPS functions over the Internet.

All the communication ports and contacts shall be capable of simultaneous communication.

2.9.1 Emergency Control Contacts

Provide normally open contacts to signal when power is supplied to the UPS from emergency engine generators or alternate source.

2.10 TEMPERATURE CONTROL

2.10.1 General

Cabinet and enclosure ventilation shall be adequate to ensure that

components are operated within their ratings. Forced-air cooled rectifier, inverter, and control unit will be acceptable. The cooling fans shall continue operation if UPS input power is lost. Redundancy shall be provided so that failure of one fan or associated circuit breaker will not cause an overheat condition. Cooling air shall enter the lower front of the cabinets and exhaust at the top. Blower power failure shall be indicated as a visual and audible alarm on the control panel. Air inlets shall have replaceable filters that may be located on the inside of the cabinet doors and shall be easily accessible for replacement.

2.10.2 Blower Power Source

Blower power source shall be internally derived from the output side, input and output sides of UPS module, with automatic transfer arrangement.

2.10.3 Temperature Sensors

Temperature sensors shall be provided to monitor the air temperature. Separate sensors shall monitor the temperature of rectifier and inverter heat sinks. Separate sensors shall also monitor the transformer temperature. Critical equipment over-temperature indication shall start a timer that shall shut down the UPS system if the temperature does not return below the setpoint level recommended by the UPS manufacturer.

2.11 BATTERY SYSTEM

2.11.1 General

Battery system shall contain the battery cells, racks, battery disconnect, battery monitor and cabinet, if required. A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module. The battery shall be of heavy-duty, industrial design suitable for UPS service. The cells shall be provided with flame arrestor vents, intercell connectors and cables, cell-lifting straps, cell-numbering sets, and terminal grease. Intercell connectors shall be sized to maintain terminal voltage within voltage window limits when supplying full load under power failure conditions. Cell and connector hardware shall be stainless steel of a type capable of resisting corrosion from the electrolyte used.

2.11.2 Battery Ratings

a. Type: lead calcium, lead antimony, nickel cadmium.

b. Specific gravity when fully charged: 1.215.

c. End voltage 1.67 volts per cell.

d. Float voltage: 2.17 to 2.26, 2.15 to 2.22 volts per cell.

e. Equalizing voltage: 2.33 to 2.38 volts per cell.

2.11.3 Battery Construction

The battery shall be of the valve-regulated, sealed, non-gassing, recombinant type, wet-cell type and shall be supplied complete with thermometer and hydrometer holder.

2.11.4 Battery Cabinet

The battery pack assembly shall be furnished in a battery cabinet matching the UPS cabinet. The battery cabinet shall be designed to allow for checking the torque on the connections in the battery system and to provide adequate access for annual housekeeping chores. External wiring interface shall be through the bottom or top of the assembly. A smoke and high temperature alarm shall annunciate detection of either smoke or high temperature within the battery cabinet.

2.11.5 Battery Rack

The battery shall be provided with a suitable number of two-tier, three-tier racks to fit the room layout shown. Battery rack shall be steel and shall be protected with electrolyte-resistant paint. Battery rack shall be shipped unassembled and shall include hardware necessary for assembly. Each rack shall be complete with bus bars to accommodate cables from UPS module. Bus bar connectors for battery-to-battery connections and high-flex multi-stranded copper cable (ASTM B 173 stranding class H) with proper cable supports for connecting top row of batteries to bottom row of batteries at rack ends shall be provided. End sections shall be cut to length to prevent wasting floor space.

2.11.6 Cell-Terminal Covers

Acid-resistant transparent cell-terminal covers not exceeding 6 feet in length and with vent holes drilled on top where needed shall be provided.

2.11.7 Battery Disconnect

Each battery pack assembly shall have a fused disconnect switch provided in a NEMA 1 enclosure, finished with acid-resistant paint and located in line with the assembly. Switch shall be complete with line side and load side bus bars for connection to battery cells. Switch shall be rated as indicated on shop drawings V dc, as indicated on shop drawings amperes, 3-pole with interrupting rating as required by system capacity, and shall have an external operator that is lockable in the "off" position.

2.11.8 Seismic Requirements

The battery support system shall conform to Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and to 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, be as indicated.

2.11.9 Battery Monitor

A battery monitor shall be provided for each battery pack assembly. At a minimum, this device shall monitor the following parameters:

a. Total system voltage.

b. Ambient room temperature.

c. Total battery discharge cycles with a duration of 30 seconds or less, greater than 30 seconds but less than 5 minutes, greater than 5 minutes.

The monitor shall also record the total accumulated discharge minutes and accumulated battery system discharge kW hours.

2.12 FACTORY TESTING

The UPS system shall be factory tested to meet the requirements specified using a test battery (not the battery to be supplied with the system). UPS module shall be factory load tested as an independent assembly with 3-phase ac input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Load shall be balanced at rated kVA and rated power factor. Factory tests for the UPS module shall be run under full load, and will be witnessed by the Government. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. As a minimum, the factory tests shall include the parameters described in paragraphs ac Input, ac Output, Transient Response and Efficiency. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings. The Contracting Officer shall be notified in writing at least 2 weeks before testing. Factory-test time shall not be used for system debugging and/or checkout. Such work shall be done prior to notifying the Government that the system is ready for testing. Factory tests shall be performed during normal business hours. The system shall be interconnected and tested for an additional 8 hours to ensure proper wiring and performance.

2.12.1 Transient Tests

Transient tests shall be conducted using high-speed oscillograph type recorders to demonstrate the operation of the components to the satisfaction of the Government. These tests shall include 50 percent to 100 percent load changes, manual transfer, manual retransfer, low dc bus initiated transfer and low ac output bus transfer. A recording instrument equipped with an event marker shall be used.

2.12.2 Efficiency Tests

Testing for efficiency shall be performed at zero output up to 100 percent of stated kVA output in 25 percent steps, 0.8, 0.9 power factor, with battery fully charged and floating on the dc bus, with nominal input voltage, and with module connected to represent actual operating conditions.

2.13 CABLE LUGS AND TERMINATIONS

2.13.1 Cable Lugs

Provide appropriate compression type lugs on all ac and dc power connections to the UPS system and battery as required. Aluminum or bare copper cable lugs are not suitable.

2.13.2 Terminations

Terminals shall be supplied for making power and control connections. Terminal blocks shall be provided for field wiring terminals. Terminal blocks shall be heavy-duty, strap-screw type. Terminal blocks for field wiring shall be located in one place in each module. Control wiring shall be extended to the terminal block location. No more than two wires shall land on any terminal point. Where control wiring is attached to the same point as power wiring, a separate terminal shall be provided. If bus duct is used, bus stubs shall be provided where bus duct enters cabinets.

2.14 INSPECTION

Inspection before shipment is required. The manufacturer shall notify the Government at least 2 weeks before shipping date so that an inspection can be made.

2.15 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.16 MANUFACTURER'S NAMEPLATES

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.17 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.1.1 Control Cable

UPS control wiring shall be installed in individual separate rigid steel conduits, unless connections are made between side by side matching cabinets of UPS. Tag control wires with numeric identification tags corresponding to the terminal strip location to where the wires are connected. In addition to manufacturer's requirements, provide four additional spare conductors between UPS module and remote alarm panel in same conduit. When routing control cables inside UPS module, maintain a minimum 6 inches separation from power cables.

3.1.2 Grounding Conductor

Provide an insulated equipment grounding conductor in feeder and branch circuits. Conductor shall be separate from the electrical system neutral conductor. Ground battery racks and battery breaker cabinets with a separate equipment grounding conductor to the UPS cabinet.

3.1.3 UPS Output Conductors

Isolate the UPS output conductors from the UPS cabinet to the critical load

panels and from other conductors by installing in separate conduit. Isolation shall prevent inductive coupling from other conductors.

3.1.4 DC Power Conductors

When installed in conduits, place dc power conductors from the UPS cabinet to the battery circuit breaker such that each conduit contains an equal number of positive and negative conductors, for example, two positive and two negative conductors in each conduit.

3.1.5 Seismic Protection

The UPS enclosure shall conform to Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and to 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, be as indicated.

3.1.6 Conduit Entries

Conduit entries shall use the available conduit areas shown on manufacturer's installation drawings. Conduit entries shall not be made through the front, side or rear panels of the UPS or Maintenance Bypass Cabinet.

3.1.7 Battery Rack Assembly

Battery racks are typically shipped dismantled in separate rail, frame, and brace packages. Ensure that manufacturer furnished assembly hardware is used to assemble battery racks. Installation of battery racks shall conform to the manufacturer's instructions.

3.1.8 Battery Cabinet Assembly

Battery cabinets are typically factory assembled for up to 100 KVA UPS systems. Battery cabinets for larger units typically require assembly at the site. Installation of battery cabinets shall conform to the manufacturer's instructions.

3.1.9 Battery Installation

Installation of batteries shall conform to the manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

Contractor shall notify Contracting Officer in writing at least 45 calendar days prior to completion of the UPS system installation. At this time the Contractor, will schedule the UPS manufacturer's technical representative to inspect the completed installation. The UPS technical representative shall provide instruction for activity personnel as specified in paragraph titled "DEMONSTRATION".

3.2.1 Installation Preparation

The following items shall be completely installed by the Contractor and be operational prior to the arrival of the UPS representative for inspection, unit start-up and testing:

a. Ventilation equipment in the UPS and battery rooms.

b. Battery racks, cabinets and cells. This is not applicable for

maintenance-free battery.

c. Battery connections including cell-to-cell, tier-to-tier, and rack-to-rack connections, with correct polarity;

d. DC power and control connections between UPS and battery circuit breaker, with correct polarity;

e. DC power connection between battery circuit breaker and battery, with correct polarity;

f. Clockwise phase rotation of ac power connections;

g. AC power to rectifier input bus;

h. AC power to UPS bypass input bus;

i. AC power to UPS maintenance bypass circuit breaker;

j. AC power from UPS output to UPS maintenance bypass output circuit breaker;

k. Remote monitors and control wiring;

l. UPS system and battery system properly grounded;

m. Emergency shower and eye wash;

n. Control connections between UPS and emergency engine generator signal contacts;

o. Control connections between UPS module and UPS maintenance bypass cabinet;

p. Clean and vacuum UPS and battery room floors, battery cells, and UPS equipment, both inside and outside.

q. Ensure that shipping members have been removed.

r. Provide IEEE Std 450 battery installation certification.

3.2.2 Initial Inspection and Tests

The UPS technical representative and the Contracting Officer, in the presence of the Contractor, will inspect the completed installation. The Contractor shall correct construction or installation deficiencies as directed. Perform acceptance checks in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections, performed in accordance with NETA ATS.

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with drawings, specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Inspect doors, panels, and sections for paint, dents, scratches, fit, and missing hardware. Inspect the displays for scratches, dark pixels or uneven brightness.

(3) Inspect anchorage, alignment, grounding, and required clearances.

(4) Verify that fuse sizes and types correspond to drawings.

(5) Verify the unit is clean inside and out.

(6) Test all electrical and mechanical interlock systems for correct operation and sequencing.

(7) Inspect bolted electrical connections for high resistance using one of the following methods:

(a) Use a low-resistance ohmmeter.

(b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(c) Perform thermographic survey.

(8) Verify operation of forced ventilation.

(9) Verify that vents are clear and new clean filters are installed.

3.2.3 Performance Tests

Provide equipment, test instruments, power, load bank, materials and labor required for tests. Contracting Officer will witness all tests and the tests shall be subject to his approval. Perform tests in accordance with the manufacturer's recommendations and include the following electrical tests.

3.2.3.1 UPS Unit Performance Tests

Upon completion of battery activation procedures, Contractor shall connect load bank to UPS output. Load bank required shall be determined by the following:

UPS KVA RATING X 0.8 = KW of LOAD BANK

Performance test is to be run under the supervision of the UPS technical representative. UPS unit shall be operated under full load for a minimum of one hour. Contractor shall be required to operate feeder and bypass power feeder breakers during testing of the UPS.

a. Electrical Tests

(1) Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

(2) Test static transfer from inverter to bypass and back. Use normal load, if possible.

(3) Set free running frequency of oscillator.

(4) Test dc undervoltage trip level on inverter input breaker. Set according to manufacturer's published data.

(5) Test alarm circuits.

(6) Verify synchronizing indicators for static switch and bypass switches.

(7) Perform electrical tests for UPS system breakers.

(8) Perform electrical tests for UPS system batteries.

b. Test Values

(1) Compare bolted connection resistances to values of similar connections.

(2) Verify bolt-torque levels.

(3) Micro-ohm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.

c. Load Test

The installed system shall be load tested for a continuous 24 hour period by means of resistive load banks. The system shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. Provide resistive load banks of total kW load of equipment to facilitate startup under load conditions, and to conduct load tests described above. Instrument readings shall be recorded every half hour for the following:

(1) Input voltage (all three phases).

(2) Input current (all three phases).

(3) Input frequency.

(4) Battery voltage.

(5) Output voltage (all three phases).

(6) Output current (all three phases).

(7) Output kilowatts.

(8) Output frequency.

d. Full Load Burn In Test

The installed system shall undergo an additional full load burn-in period of 24 continuous hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. During the burn-in period, the following tests shall be performed:

(1) With the UPS carrying maximum continuous design load and supplied from the normal source, switch 100 percent load, 50 percent load, on and off a minimum of five times within the burn-in period.

(2) With the UPS carrying maximum continuous design load and supplied from the emergency source, repeat the switching operations

described in step a. Also, verify that the UPS module rectifier charger unit(s) go into the second-step current limit mode.

(3) With the UPS carrying maximum continuous design load and operating on battery power, repeat the switching operations described in step a above.

(4) Continue operation on battery power for 1 minute, then restore normal power.

The Contractor shall furnish a high-speed dual trace oscillograph to monitor ten or more cycles of the above tests at the ON and OFF transitions and two typical steady-state periods, one shortly after the load is energized (at 30 to 60 seconds) and one after operation has stabilized (at 8 to 10 minutes). Four copies of the traces shall be delivered to the Contracting Officer.

e. Battery Discharge Test

With the battery fully charged, the system shall undergo a complete battery discharge test to full depletion and a recharge to nominal conditions. Instrument readings shall be recorded every minute during discharge for the following:

(1) Battery voltage.

(2) Battery current.

(3) Output voltage (all three phases).

(4) Output current (all three phases).

(5) Output kilowatts.

(6) Output frequency.

3.2.3.2 Emergency Generator Operation

Test UPS to observe operation with emergency generator service. UPS technical representative shall verify UPS battery current limiting feature functions properly.

3.2.3.3 Battery Performance Test (Constant KW)

Furnish all labor, material and test equipment necessary to conduct performance test under the direction of UPS technical representative. The following shall be accomplished:

a. Install a calibrated voltmeter across the battery terminals to measure voltage, and install a calibrated voltmeter across the UPS dc shunt to read charging current. UPS technical representative will advise connection to dc shunt.

b. Record temperature of pilot cells in battery immediately prior to start of discharge performance test.

c. Read and record total battery voltage and battery current at start of discharge and every minute during discharge test.

d. Record minutes and seconds when battery voltage drops below minimum discharge voltage of 291 volts dc. On initial discharge test, a battery may be expected to deliver 95 percent of its rated capacity. This will increase to 100 percent after several complete discharge cycles or after 12 months of float charge service.

e. Should battery fail to meet the requirements of the first discharge performance test, open the inverted output breaker. Then put battery on equalizing charge, with rectifier adjusted to normal equalizing voltage of 424 volts dc. Equalize for a minimum of 100 hours. Measure and record time and battery voltage. Run a second discharge performance test.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

Furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintennace of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. Provide 8 hours of instruction for all personnel. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instuction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications. Field training shall be videotaped and the tape shall be left with the Contracting Officer. A factory training videotape shall be provided as part of the training materials.

3.4 FINAL ADJUSTMENTS

a. Remove load bank and reconnect system for normal operation.

b. Equalize battery at 424 volts for a period of 72 hours.

c. Bring electrolyte level of all cells up to the bottom of the high level line by adding original filling gravity electrolyte.

d. Resume charging battery at normal float voltage of 411 volts dc.

e. Check battery connections are properly torqued to manufacturer's specifications. Take and record, for cell-to-cell and terminal connections, detailed micro-ohm resistance readings. Remake connections having a resistance of more than 10 percent above the average.

f. All manufacturer's data and operation manuals, which are an integral part of, and shipped with UPS, shall be delivered to Contracting Officer.

3.5 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as

indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.6 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.7 DISPOSAL

Upon completion of UPS installation and testing, Contractor shall remove and dispose of empty, partially full and excess acid drums, including shipping containers, obsolete batteries, and obsolete UPS modules. Removal shall be accomplished off-base and in conformance with local laws and regulations regarding disposal of hazardous material.

-- End of Section --

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 780	(1997) Lightning Protection Code

UNDERWRITERS LABORATORIES (UL)

UL ECMD	(1990) Electrical Construction Materials Directory
UL 96	(1994; R 1996) Lightning Protection Components
UL 96A	(1994; Bul. 1995) Installation Requirements for Lightning Protection Systems
UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.2.1 Verification of Dimensions

Contractor shall become familiar with all details of work, verify all dimensions in field, and shall advise Contracting Officer of any discrepancy before performing work. No departures shall be made without prior approval of Contracting Officer.

1.2.2 System Requirements

Materials shall consist of standard products of a manufacturer regularly engaged in production of lightning protection systems and shall be manufacturer's latest UL approved design. Lightning protection system shall conform to NFPA 70, NFPA 780, UL 96 and UL 96A.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Overall lightning protection system

Each major component

SD-03 Product Data

Air terminals

Conductors

Ground rods

Connectors

Fittings, brackets, fasteners

SD-06 Test Reports

Grounding system test

Lightning protection system inspection

SD-07 Certificates

UL listing or label

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.4.1 Installation Drawings

a. Submit installation shop drawing for the overall lightning protection system. Drawings shall include physical layout of the equipment, mounting details, relationship to other parts of the work, and wiring diagram.

b. Submit detail drawings for each major component to include manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 UL Listing or Label

Submit proof of compliance. Label of or listing in UL ECMD is acceptable evidence. In lieu of label or listing, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.5 SITE CONDITIONS

Contractor will become familiar with details of the work, verify dimensions in the field, and advise Contracting Officer of discrepancies before performing work. Deviations from contract drawings will not be made without prior approval of Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings or oversize conductors. Where mechanical hazard is involved, increase conductor size to compensate for hazard or protect conductors by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic).

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.1.2 Copper

Provide copper conductors on nonmetallic stacks that do not weigh less than 319 pounds per thousand feet, and provide cable such that the size of any strand in the cable is not less than No. 15 AWG. Provide thickness of web or ribbon on stacks that is not less than No. 12 AWG. Provide loop conductors that are comprised of copper conductors not smaller than No. 1/0 AWG.

2.1.3 Aluminum

Do not allow aluminum to contact the earth and do not use in any other manner that will contribute to rapid deterioration of the metal. Observe appropriate precautions at connections with dissimilar metals in accordance with NFPA 70 Article 110-14. Provide aluminum cable conductors for bonding and interconnecting metallic bodies to main cable that are at least equivalent to strength cross-sectional area of a No. 4 AWG aluminum wire. When perforated strips are provided, use strips that are much wider than solid strips. Use a strip width that is at least twice that of the diameter of the perforations. Use an aluminum strip which has a thickness of not less than the diameter of No. 12 AWG and at least 1 1/2 inches wide for connecting exposed water pipes.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide terminals in accordance with UL 96, except provide Class II for Class I and Class II applications. Support air terminals more than 24 inches in length by suitable brace, with guides, not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods made of copper-cladsteel, stainless steel, solid copper conforming to conform to UL 467, galvanized ferrous rods conforming to ANSI C135.30. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length. Do not mix ground rods of copper-clad steel, stainless steel, galvanized ferrous, or solid copper on the job.

2.2.3 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.4 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780.

2.2.5 Lightning Protection Components

Provide bonding plates, air terminal supports, chimney bands, clips, and fasteners that conform to UL 96 classes as applicable.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, grounding electrodes and ground loop conductor. Electrically interconnect lightning protection system to form the shortest distance to ground. Do not use nonconducting parts of the structure as part of the building's lightning protection system. Expose conductors on the structures except where conductors are required to be in protective sleeves. Interconnect secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or above the level of the grounded metallic parts.

3.1.1 Air Terminals

Air terminal design and support conforming to NFPA 780. Rigidly connect terminals to, and make electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal. Provide pressure connector or crimped joint with a dowel or threaded fitting to connect ground rod conductor with air terminal. Set air terminals at ends of structures not more than 2 feetfrom ends of ridges and corners of roofs. Do not exceed 25 feet in spacing of 2 foot high air terminals on ridges, parapets, and around perimeter of building with flat roofs. When necessary to exceed this spacing, increase specified height of

air terminals not less than 2 inches for each foot of increase over 25 feet. On large flat, or gently sloping roofs, as defined in NFPA 780, place air terminals at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 50 feet in length. Secure air terminals against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces which are permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings such as smokestacks and other metal objects that are at least 3/16 inch thick and that do not contain hazardous materials, need not be provided with air terminals. However, bond these metal objects to a lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where metal ventilators are installed, mount air terminals thereon, where practical. Bond air terminals, erected by necessity adjacent to a metal ventilator, to the ventilator near the top and bottom. Where nonmetallic spires, steeples, or ventilators are present, mount air terminals to the side. In addition, where spires or steeples project more than 10 feet above the building, continue conductor from air terminal to nearest down conductor securely connect thereto.

3.1.2 Roof Conductors

Connect roof conductors directly to the roof or ridge roll. Avoid sharp bends or turns in conductors. Do not make turns of less than 8 inches. Preserve horizontal or downward course on conductors. Rigidly fasten conductors every 3 feet along the roof and down the building to the ground. Rigidly connect metal ventilators to the roof conductor at three places. Make connections electrically continuous. Course roof conductors along contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Connect roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs shall be connected to form a closed loop.

3.1.3 Down Conductors

Make down conductors electrically continuous from air terminals and roof conductors to grounding electrodes. Course down conductors over outer extreme portions of the building, such as corners, with consideration given to location of ground connections and air terminals. Provide each building or structure not less than two down conductors located as widely separated as practicable, such as at diagonally opposite corners. Rectangular structures having gable, hip, or gambrel roofs more than 110 feet long, provide at least one additional down conductor for each additional 50 feet of length or fraction thereof. Rectangular structures having French, flat, or sawtooth roofs exceeding 250 feet in perimeter, provide at least one additional down conductor for each 100 feet of perimeter or fraction thereof. L- or T-shaped structure, provide at least one additional down conductor. H-shaped structure, at least two additional down conductors. Wing built structure, at least one additional down conductor for each wing. Irregularly shaped structures, provide enough conductors so that the average distance between them along the perimeter is not greater than 100 feet. Structures exceeding 50 feet in height, provide at least one additional down conductor for each additional 60 feet of height or fraction thereof, except that this application will not cause down conductors to be placed about the perimeter of the structure at intervals of less than 50 feet. Install additional down conductors when necessary to avoid "dead ends" or branch conductors exceeding 16 feet in length, ending at air terminals. Equally and symmetrically spaced down conductors about the perimeter of the structure. Protect conductors where necessary, to prevent

physical damage or displacement to the conductor with preformed hot-dipped sheet steel guard, No. 14 gauge, minimum extending from 6-inches to at least 4.5 feet above ground line.

3.1.4 Interconnection of Metallic Parts

Connect metal doors, windows, and gutters directly to ground or down conductors using not smaller than No. 6 copper conductor, or equivalent. Where there is probability of unusual wear, mechanical injury, or corrosion, provide conductors with greater electrical capacity than normal or protect the conductor. Provide mechanical ties or pressure connectors between grounds and metal doors and windows.

3.1.5 Ground Connections

Securely connect conductor forming continuations of down conductors from structure to grounding electrode in a manner to ensure electrical continuity between the two. Provide clamp type connections or welds (including exothermic) for continuation. Provide a ground connection for each down conductor. Attach down conductors to ground rods, plates by welding (including exothermic), brazing, or clamping. Provide clamps suitable for direct burial. Protect ground connection from mechanical injury. Bond metal water pipes and other large underground metallic objects together with all grounding mediums. In making ground connections, take advantage of all permanently moist places where practicable, although avoid such places when area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.1.6 Grounding Electrodes

Provide grounding electrode for each down conductor. Extend driven ground rods into the existing undisturbed earth for a distance of not less 10 feet. Set ground rods less than 2 feet nor more than 10 feet, from the structure. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum resistance of a driven ground rod shall be 10 ohms, under normally dry conditions when a ground loop is not used. Use a ground loop when two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground loop, provide continuous No. 1/0 bare stranded copper cable or equivalent material having suitable resistance to corrosion. Lay ground loop around the perimeter of the structure in a trench not less than 30 inches below grade, at a distance not less than 2 feet nor more than 10 feet from the nearest point of the structure. Install a ground loop in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable. Make connections between ground conductors and grounds or ground loop, and between ground loop and grounds electrically continuous. Where so indicated, provide an alternate method for grounding electrodes in shallow soil by digging trenches radially from the building. Provide 1/0 bare copper cable arranged in a star pattern with the structure at the center for radial systems. Bury the radials at least 30 inches inches below grade external to the structure. Lower ends of down conductors or their equivalent in the form of metal strips or wires are buried in trenches.

3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so that they are electrically continuous. Connect air terminals so that they are electrically continuous with the metal roof as well as the roof conductors and down conductors. Bond ridge cables and roof conductors to the roof at upper and lower edges of roof and at intervals not to exceed 100 feet. Bond down conductors to roof conductors and to lower edge of metal roof. Where metal of roof is in small sections, make connections between air terminals and down conductors to at least four sections of the metal roof. Make connections electrically continuous and have a surface contact of at least 3 square inches.

3.2.2 Metal Roofs with Metal Walls

Bond metal roof and metal walls so that they are electrically continuous and considered as one unit. Connect air terminals to and make them electrically continuous with the metal roof as well as the roof down conductors. Bond all roof conductors and down conductors to metal roof or metal walls at upper and lower edges at intervals not to exceed 100 feet. Make all connections electrically continuous and have surface contact of at least 3 square inches.

3.2.3 Steel Frame Building

Make the steel framework of the building electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding unless another specific method is indicated. Connect air terminals to the structural steel framework at the ridge. Provide short runs of conductors to join air terminals to the metal framework so that proper placing of air terminals is maintained. A separate down conductors from air terminals to ground connections are not required. Where water system enters the building, securely connect structural steel framework and water system at point of entrance by a ground connector. Make connections to pipes by means of ground clamps with lugs. Make connections to structural framework by means of nut and bolt or welding. Make connections between columns and ground connections at bottom of steel columns. Make ground connections to grounds or ground loop runs from not less than one-half of the columns distributed equally around perimeter of structure. When no water system enter the structure, run ground connections from steel columns distributed equally around the perimeter of the structure. Bond metal doors, windows, gutters, and similar metal installation to steel work of the building. Provide a grounding electrode for each ground connection.

3.2.4 Ramps and Covered Passageways

Ramps and covered passageways which are in the zone of protection of a lightning protection system, as defined by NFPA 780, need no additional lightning protection. However, ramps and covered passageways which are outside the zone of protection of a lightning protection system shall be provided with a lightning protection conforming to the requirements for lightning protection systems for buildings of similar construction. Place a down conductor and a driven ground at one of the corners where the ramp connects to each building or structure. Connect down conductor and driven ground to the ground loop or nearest ground connection of the building or structure. Where buildings or structures and connecting ramps are clad with metal, connect metal of the buildings or structures and metal of the

ramp in a manner to ensure electrical continuity, in order to avoid the possibility of a flash-over or spark due to a difference in potential. Make connections electrically continuous and have a surface contact area of at least 3 square inches.

3.2.5 Tanks and Towers

3.2.5.1 Wooden Tanks and Towers

Electrically interconnect lightning protection system components (such as: air terminals, ridge cables, down conductors, ground connections, and grounds) to form the shortest distance to ground without passing through any nonconducting parts of the structure. Where the roof of the structure ends in a peak, a single air terminal not less than 2 feethigh will be regarded as sufficient. When structure does not end in a peak, provide air terminals not less than 2 feet high at intervals not exceeding 25 feet along the perimeter of the structure. When the tank or tower is an adjunct of a building, near or touching the perimeter, extend one of the down conductors directly to a ground connection and connect the other to lightning protection of the building. When tank or tower is set well within the perimeter of the building, connect both down conductors to lightning protection system of the building. When height of the structure exceeds 100 feet, cross-connect down conductors midway between the top and bottom. Where buried metal pipes enter tank or tower, connect one down conductor to pipes, approximately 1 foot below grade. Ground metal guy wires or cables set in concrete or attached to buildings or nonconducting supports to a ground rod driven full length into the ground.

3.2.5.2 Metal or Reinforced-Concrete Tanks and Towers

Make metal or reinforcing steel electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding metal and tying or clipping reinforcing bars, unless a specific method is noted on the drawings. Air terminals and down conductors are required except on bolted, riveted, or welded 3/16 inch minimum steel plate tanks. Ground connections and grounding electrodes are not required on metal tanks that are electrically continuous with a metallic underground pipe system. On other structures, provide two ground connections approximately 180 degrees apart at the base of the structure. Connect each buried metal pipe entering the tank or tower to one ground connection approximately one foot below finished grade. Ground metal guy wires on tanks and towers. Metal guy wires or cables attached to steel anchor rods set in earth will be considered as grounded. Ground metal guy wires or cables set in concrete or attached to buildings or nonconducting supports to a ground rod driven full length into the ground.

3.2.6 Stacks

Ground metal guy wires for stacks. Metal guy wires or cables attached to steel anchor rods set in earth will be considered as sufficiently well grounded. However, ground metal guy wires or cables attached to anchor rods set in concrete or attached to buildings or nonconducting supports to a ground rod driven full length into the ground.

3.2.6.1 Metal Stacks

Make metal smokestacks electrically continuous and to ground. Heavy-duty metal stacks having a metal thickness of 3/16 inches or greater do not require air terminals or down conductors. Otherwise, provide two ground

rods, grounding plates driven full length into the earth. Locate ground rods, grounds plates approximately 180 degrees apart and set ground rods, grounding plates not less than 3 feet nor more than 8 feet from the nearest point of the stack foundation.

3.2.6.2 Nonmetallic Stacks

On nonmetallic smokestacks constructed of brick, hollow tile, or concrete, make the air terminals solid copper, copper alloy, stainless steel or Monel metal. Distribute uniformly about the rim of the stack at intervals not exceeding 8 feet and extending at least 30 inches above the rim of stack. Electrically connect air terminal together by means of a metal band or ring to form a closed loop about 2 feet below the top of the stack. Where the stack has a metal crown, connect air terminals to the metal crown. Where stacks have metal lining extending part way up, connect lining to air terminal at its upper end and ground at the bottom. Provide at least two down conductors on opposite sides of the stack leading from the ring or crown at the top to the ground. When the stack is an adjunct of building near or touching the building perimeter, extend one of the conductors directly to a ground connection while the other may be connected to lightning protection system on the building. On stacks exceeding 160 feet in height, cross-connect down conductors approximately midway between the top and bottom. Reduce joints in conductors to a minimum and make joints to have the same tension strength as the conductors that are joining. Space fasteners of copper or copper-bronze alloy not over 3 feetapart for vertical conductors and not over 2 feet apart for horizontal conductors. To prevent gases from corroding copper air terminals, provide conductors and fasteners within 25 feetof the top of stack with continuous coating of hot dipped lead or an equivalent coating. Provide conductors conforming to the requirements for nonmetallic stacks for stacks partly or wholly of reinforced concrete. For nonmetallic stacks, electrically connect reinforcing steel to down conductors at top and bottom of concrete.

3.3 INTERFACE WITH OTHER STRUCTURES

3.3.1 Interconnection of Metal Bodies

Protect metal bodies of conductance when not within the zone of protection of air terminal. Bond metal bodies of conductance having an area of 400 square inches or greater or a volume of 1000 cubic inches or greater to lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 3 square inches. Make provisions to guard against the corrosive effect of bonding dissimilar metals. Bond metal bodies of inductance at their closest point to the lightning protection system using bonding conductors and fittings. Independently ground any metal body that exceeds 5 feet in any dimension, that is situated wholly within a building, and that does not at any point come within 6 feet of a lightning conductor or metal connected to a lightning protection system.

3.3.2 Fences

Except as specified below, metal fences that are electrically continuous with metal posts extending at least 2 feet into the ground require no additional grounding. Ground other fences on each side of every gate at gate posts, at corner posts, and at end posts. Bond gate to adjacent fence post utilizing flexible copper grounding braid with sufficient slack to permit 180 degree opening of the gate. Provide flexible copper ground braid which has an ampacity equivalent to that of the fence ground wire

specified herein. Provide ground rods every 1000 to 1500 feet for ground fences when fences are located in isolated places, and every 500 to 750 feet when in proximity (100 feet or less) to public roads, highways, and buildings. Provide connection to ground from the post where it is metal and is electrically continuous with the fencing using removable ground clamps on the fence posts and split-bolt connectors suitable for dissimilar metals on the fence fabric and barbed wire. Where the fence consists of wooden posts and horizontal metal strands only, run down conductors consisting of No. 8 copper wire or equivalent from the ground rod the full height of the fences and fastened to each wire, so as to be electrically continuous. Make connections to ground from the horizontal metal strand using split-bolt connectors suitable for dissimilar metals on the fence fabric and barbed wire. Ground metal fences at or near points 150 feet on each side of medium and high voltage, (meaning in excess of 600 volts,) overhead line crossings. Ground metal fences at 150 foot intervals where high and medium voltage lines are directly overhead and run parallel to the fence.

3.3.3 Exterior Overhead Pipe Lines

Properly ground overhead pipes, conduits, and cable trays on the exterior of the building that enter a building, preferably to building grounds at points where pipes enter the building. Where a separate ground is provided, bond the pipes to the building ground at points where the pipes are closest to the ground connections. In addition, bond pipes to any metallic masses that are within 6 feet of the pipe.

3.4 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore to original condition the areas disturbed by trenching, storing of dirt, cable laying, and other work. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.5 FIELD QUALITY CONTROL

3.5.1 Grounding System Test

Test the grounding system to ensure continuity and that resistance to ground is not in excess of 10 ohms. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of ground rods, resistance, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

3.5.2 Lightning Protection System Inspection

Make visual inspections to verify that there are no loose connections which may result in high resistance joints, and that conductors and system components are securely fastened to their mounting surfaces and are protected against accidental mechanical displacement.

-- End of Section --

SECTION 26 51 00

INTERIOR LIGHTING

04/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(2002; Rev. A) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 1008/A 1008M	(2002) Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM B 164	(1998) Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B 633	(1998; E 2001) Electrodeposited Coatings of Zinc on Iron and Steel

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9	(2000) Lighting Handbook, Reference and Application

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits (ANSI/IEEE)
IEEE C136.10	(1996) Roadway Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C78.42	(2001) Electric Lamps - High-Pressure Sodium Lamps
NEMA C78.81	(2001) Electric Lamps - Double-capped

	Fluorescent Lamps
NEMA C78.901	(2001) Electric Lamps - Single Base Fluorescent Lamps
NEMA C78.1375	(1996) Electric Lamps - 400-Watt, M59 Single-Ended Metal-Halide Lamps
NEMA C78.1376	(1996) Electric Lamps - 1000-Watt, M47 Single-Ended Metal-Halide Lamps
NEMA C78.1377	(1996) Electric Lamps - 175-Watt, M57 Single-Ended Metal-Halide Lamps
NEMA C78.1378	(1996) Electric Lamps - 250-Watt, M58 Single-Ended Metal-Halide Lamps
NEMA C78.1381	(1998) Electric Lamps - 70-Watt, M85 Double-Ended Metal-Halide Lamps
NEMA C78.1382	(1996) Electric Lamps - 100-Watt, M90 Single-Ended Metal-Halide Lamps
NEMA C78.1384	(1997) Electric Lamps - 150-Watt M102 Single-Ended Metal-Halide Lamps
NEMA C82.1	(1997) Electric Lamp Ballast - Line Frequency Fluorescent Lamp Ballast
NEMA C82.2	(2002) Fluorescent Lamp Ballasts - Methods of Measurement
NEMA C82.4	(2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
NEMA C82.11	(2002) High-Frequency Fluorescent Lamp Ballasts
NEMA ICS 2	(2000) Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated 600 Volts
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems Enclosures
NEMA LL 1	(1997; R 2002) Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems
NFPA 101	(2000) Life Safety Code

UNDERWRITERS LABORATORIES (UL)

UL 20	(2000; R 2002, Bul. 2002) General-Use Snap Switches
UL 595	(1985; R 1991) Marine-Type Electric Lighting Fixtures
UL 773	(1995; R 2002, Bul. 2002) Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	(1995; R 1999) Nonindustrial Photoelectric Switches for Lighting Control
UL 844	(1995; R 1999, Bul. 2002) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 924	(1995; R 2001, Bul. 2001 and 2002) Emergency Lighting and Power Equipment
UL 935	(2001; Bul. 2001) Fluorescent-Lamp Ballasts
UL 1029	(1994; R 2001) High-Intensity-Discharge Lamp Ballasts
UL 1598	(2000; Bul. 2001 and 2002) Luminaires

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 51 00, "Interior Distribution System." Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Total Harmonic Distortion (THD)

The root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IESNA HB-9, as applicable, for the lighting system specified.

SD-03 Product Data

Fluorescent lighting fixtures

Fluorescent electronic ballasts

Fluorescent electromagnetic ballasts

Fluorescent lamps

High-intensity-discharge (HID) lighting fixtures

HID ballasts

High-pressure sodium (HPS) lamps

Metal-halide lamps

Incandescent lighting fixtures

Incandescent lamps

Dimmer switch

Lighting contactor

Time switch

Photocell switch

Power hook fixture hangers

Exit signs

Emergency lighting equipment

Central emergency system

Occupancy sensors

Electronic dimming ballast

Dimming ballast controls

Light Level Sensor

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23, "Operation and Maintenance Data" and as specified

herein, showing all control modules, control zones, occupancy sensors, light fixtures, and all interconnecting control wire, conduit, and associated hardware.

1.5 QUALITY ASSURANCE

1.5.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers.

1.5.2 Lighting Fixtures, Complete With Lamps and Ballasts

Submit one sample of each fixture type and large order item for inspection, review, and approval. The sample shall be retained for comparison against the remainder of the fixtures. The sample may be used in the final fixture installation.

1.5.3 Lighting Control System

Submit operation and maintenance manuals for lighting control systems that provide basic data relating to the design, operation, and maintenance of the lighting control system for the building. This shall include:

a. Schematic diagram of the lighting control system.

b. Manufacturers' operating and maintenance manuals on active lighting control equipment. Lighting control equipment shall include, if indicated: occupancy sensors, power packs, dimming ballasts, and light level sensors.

1.6 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1598. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, NEMA C82.11, and NFPA 70 unless specified otherwise. Ballast shall provide transient immunity as recommended by IEEE C62.41. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast shall be UL listed Class P with a sound rating of "A."

f. Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

g. Ballasts shall be instant start unless otherwise indicated. Ballasts shall be programmed start where indicated. Instant start ballasts shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Programmed start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

h. Ballasts for compact fluorescent fixtures shall be programmed start.

i. Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by NEMA C78.81 and NEMA C78.901 as applicable.

j. Ballast shall be capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

k. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

a. Total harmonic distortion (THD): Shall be 20 percent (maximum).

b. Input wattage.

1. 32 watts (maximum) when operating one F32T8 lamp

2. 62 watts (maximum) when operating two F32T8 lamps

3. 92 watts (maximum) when operating three F32T8 lamps

4. 114 watts (maximum) when operating four F32T8 lamps

c. Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

d. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

2.1.1.2 F17T8 Lamp Ballast

a. Total harmonic distortion (THD): Shall be 25 percent (maximum).

b. Input wattage:

1. 34 watts (maximum) when operating two F17T8 lamps.

2.1.1.3 T-5 Long Twin Tube Lamp Ballast

a. Total harmonic distortion (THD): Shall not be greater than 25 percent when operating one lamp, 15 percent when operating two lamps, and 20 percent when operating three lamps.

b. Input wattage:

1. 45 watts (maximum) when operating one F40 T-5 lamps

2. 74 watts (maximum) when operating two F40 T-5 lamps

3. 105 watts (maximum) when operating three F40 T-5 lamps

c. Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

d. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

2.1.1.4 F96T12 Lamp Ballast

a. Total harmonic distortion (THD): Shall not be greater than 30 percent when operating one lamp and 20 percent when operating two lamps.

b. Input wattage:

1. 70 watts (maximum) when operating one F96T12 lamps

2. 113 watts (maximum) when operating two F96T12 lamps

c. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

2.1.2 Fluorescent Lamp Electronic Dimming Ballast

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with NEMA C82.11, UL 935, and NFPA 70, unless specified otherwise. Ballast shall provide transient immunity as recommended by IEEE C62.41. Ballast dimming capability range shall be from 100 to 5 percent (minimum range) of light output, flicker free. Ballast shall start lamp at any preset light output setting without first having to go to full light output. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum) at full light output, and 0.90 (minimum) over the entire dimming range.

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Ballast factor at full light output shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

e. Ballast shall be UL listed Class P with a sound rating of "A".

f. Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

g. Ballast shall be programmed start. Ballast may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

h. Ballasts for compact fluorescent fixtures shall be programmed start.

i. Ballast shall be capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

j. Total harmonic distortion (THD): Shall be 20 percent (maximum) over the entire dimming range.

k. Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by NEMA C78.81 and NEMA C78.901 as applicable.

2.1.2.1 T-8 Lamp Ballast

Input wattage, for indicated lamp quantity shall be:

a. 35 watts (maximum) when operating one F32T8 lamp.

b. 70 watts (maximum) when operating two F32T8 lamps.

c. 104 watts (maximum) when operating three F32T8 lamps.

2.1.3 Dimming Ballast Controls

The dimming ballast controls shall be a slide dimmer with on/off control. The slide dimmer shall be compatible with the ballast and control the ballast light output over the full dimming range. Dimming ballast controls shall be approved by the ballast manufacturer.

2.1.4 Light Level Sensor

UL listed. Light level sensor shall be capable of detecting changes in ambient lighting levels, shall provide a dimming range of 20 percent to 100 percent, minimum, and shall be designed for use with dimming ballast and voltage system to which they are connected. Sensor shall be capable of controlling 40 electronic dimming ballast, minimum. Sensor light level shall be adjustable and have a set level range from 10 to 100 footcandles , minimum. Sensor shall have a bypass function to electrically override sensor control.

2.1.5 Fluorescent Electromagnetic Ballasts

UL 935. Ballasts shall be high power factor type (0.9 minimum), unless indicated otherwise and shall be designed to operate on the voltage system to which they are connected. Ballasts shall be Class P and shall have sound rating "A" unless otherwise noted. Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90 degrees C when installed in an ambient temperature of 40 degrees C. Electromagnetic ballasts for T-8 and T-12 lamps shall be energy saving. Provide three lamp fixtures with two ballasts per fixture.

2.1.5.1 Electromagnetic Energy-Saving Ballasts

NEMA C82.1. Provide energy-saving fluorescent ballasts of the CBM certified full light output type except where fixtures are provided with low temperature ballasts. Ballasts shall have an average input wattage of 40 or less when operating one 32-watt F32T8 lamp, 45 or less when operating two 17 watt F17T8 lamps, 72 or less when operating two 32 watt F32T8 lamps, 136, 123 or less when operating two 60-watt F96T12 lamps ___ or less when operating _____ lamps tested in accordance with NEMA C82.2 methods. Provide ballasts which are compatible with energy-saving lamps.

2.1.5.2 Electromagnetic Ballasts for Compact Fluorescent Lamps

Provide electromagnetic ballasts for compact fluorescent lamps.

2.1.5.3 Electromagnetic Low Temperature Ballasts

Provide fluorescent ballasts having a minimum starting temperature of zero degrees F, minus 20 degrees F, for 800 milliampere, high output (HO) lamps in fixtures mounted in cold rooms, outdoors, in unheated buildings, and as indicated.

2.1.5.4 Electromagnetic Ballasts for T-5 Long Twin Tube Lamps

Provide electromagnetic ballasts with an average input wattage of 49 or less when operating one, 86 or less when operating two, 40-watt T-5 long twin tube lamps.

2.1.6 Fluorescent Lamps

a. T-8 rapid start low mercury lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.

b. T-8 rapid start lamp, 17 watt (maximum), nominal length of 24 inches, 1300 initial lumens, CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.

c. T-8 instant start lamp, 59 watts (maximum), nominal length of 96 inches, minimum CRI of 75, 5800 initial lumens, color temperature of 3500 K, and average rated life of 15,000 hours.

d. T-12 slim line lamps shall be rated 60 watts (maximum), 5750 initial lumens (minimum), 12,000 hours average rated life.

e. T-5, long twin tube fluorescent lamp, 40 watts (maximum), 3500 K, 22.6 inches maximum length, 20,000 hours average rated life, 3150 initial lumens, CRI of 80 (minimum), 2G11 Type base.

f. T-8, U shaped fluorescent lamp, 31 watts maximum, 2600 initial lumens (minimum), 3500 K, 75 CRI (minimum), 20,000 hours average rated life, 1.625 inch leg spacing.

g. Compact fluorescent lamps shall be: CRI 80, minimum, 3500 K, 10,000 hours average rated life, and as follows:

1. T-4, twin tube, rated 5 watt, 250 initial lumens (minimum), 7 watts, 400 initial lumens (minimum), 9 watts, 600 initial lumens (minimum), and 13 watts, 825 initial lumens (minimum), as indicated.

2. T-4, double twin tube, rated 13 watts, 900 initial lumens (minimum), 18 watts, 1200 initial lumens (minimum), and 26 watts, 1800 initial lumens (minimum), as indicated.

Average rated life is based on 3 hours operating per start.

2.1.7 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall use lamps as indicated.

2.1.8 Open-Tube Fluorescent Fixtures

Provide with self-locking sockets, or lamp retainers (two per lamp). Provide lamps with shatter resistant coating, non-yellowing, nominal thickness of 15 mils, and with 97 percent (minimum) light transmission. Provide a clear polycarbonate protective sleeve with end caps, over lamp, with 95 percent (minimum) light transmission. The sleeve shall be rated to withstand the thermal profile of the lamp and ballast.

2.1.9 Air Handling Fixtures

Fixtures used as air handling registers shall meet requirements of NFPA 90A.

2.1.10 Electromagnetic Interference Filters

Provide in each fluorescent fixture mounted in shielded enclosures where indicated. Filters shall be integral to the fixture assembly with one filter per ballast and shall suppress electromagnetic interference in the

AM radio band from 500 to 1700 kHz. Filters shall be in the circuit serving the lighting fixtures mounted where indicated and shall conform to requirements of Section 26 35 46.00 20, "Radio Frequency Interference Power Line Filters."

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1598. Provide HID fixtures with tempered glass lenses when using metal-halide lamps.

2.2.1 HID Ballasts

UL 1029 and NEMA C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature of 40 degrees C.

c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.2.2 High-Pressure Sodium (HPS) Lamps

NEMA C78.42 wattage as indicated. 150 watt lamps, if required, shall be 55 volt type.

2.2.2.1 Standby HPS Lamps

Standby HPS lamps shall have two arc tubes and an average rated life of 40,000 hours (minimum) and hot restart instant lumen output shall be 8 percent, minimum, of total light output.

2.2.3 Metal-Halide Lamps

a. 70 watt conforming to NEMA C78.1381

b. 100 watt conforming to NEMA C78.1382

c. 150 watt conforming to NEMA C78.1384

d. 175 watt conforming to NEMA C78.1377

e. 250 watt conforming to NEMA C78.1378

f. 400 watt conforming to NEMA C78.1375

g. 1000 watt conforming to NEMA C78.1376

2.3 INCANDESCENT LIGHTING FIXTURES

UL 1598.

2.3.1 Incandescent Lamps

Provide the number, type, and wattage indicated.

2.3.2 Incandescent Dimmer Switch

UL 20, single-pole, 600 watt, 120 volt ac, full-range rotary on-off type with built-in electromagnetic interference filter.

2.4 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

2.5 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers shall be shock-absorbing type where indicated. Hangers shall allow fixtures to swing within an angle of 45 degrees. Brace pendants 4 feet or longer provided in shops or hangers to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 0.18 inch diameter.

2.6 FIXTURES FOR HAZARDOUS LOCATIONS

In addition to requirements stated herein, provide fluorescent, HID, incandescent fixtures for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated. Fixture shall also conform to UL 595 for marine environments as indicated.

2.7 LIGHTING CONTACTOR

NEMA ICS 2, electrically, mechanically held contactor. Contacts shall be rated volts, amperes, and poles as indicated on shop drawings . Coils shall be rated as indicated on shop drawings volts. Rate contactor as indicated. Provide in NEMA 1, 4 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor. Provide contactor with hand-off-automatic, on-off selector switch.

2.8 TIME SWITCH

Astronomic dial type or electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated as indicated volts, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 15 hours following power failure.

Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface, flush-mounted, NEMA 1, 3 enclosure conforming to NEMA ICS 6.

2.9 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated as indicated on shop drawings volts ac, 60 Hz with single-throw contacts, single pole double-throw (SPDT) contacts for control of mechanically held contactors, rated 1000W. Switch shall turn on at or below 3 footcandles and off at 2 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide switch:

a. Integral to the luminaire. rated 1000W minimum. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.

b. In a U.V. stabilized polycarbonate housing with swivel arm and adjustable window slide, rated 1800 VA, minimum.

c. In a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to IEEE C136.10, rated 1800 VA, minimum.

d. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

2.10 POWER HOOK FIXTURE HANGERS

Provide UL listed assembly including through-wired power hook housing, interlocking plug and receptacle, power cord, and fixture support loop. Power hook housing shall be cast aluminum having two 3/4 inch threaded hubs. Support hook shall have safety screw. Fixture support loop shall be cast aluminum with provisions for accepting 3/4 inch threaded fixture stems. Power cord shall include 16 inches of 3 conductor No. 16 Type SO cord. Assembly shall be rated 120 volts or 277 volts, 15 amperes, 480 volts, 20 amperes.

2.11 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered remote-powered type.

2.11.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, test switch, pilot light, integral self-testing module and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum). The light emitting diodes shall have rated lamp life of 70,000 hours (minimum).

2.11.2 Remote-Powered Exit Signs

Provide remote ac/dc exit signs with provisions for wiring to external ac and dc power sources. Provide signs with a minimum of two ac lamps for normal illumination and a minimum of two dc lamps for emergency lighting.

2.12 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated. Provide accessories required for remote-mounted lamps where indicated. Remote-mounted lamps shall be as indicated.

2.12.1 Emergency Lighting Unit

Provide as indicated. Emergency lighting units shall be rated for 12 volts, except units having no remote-mounted lamps and having no more than two unit-mounted lamps may be rated 6 volts. Equip units with brown-out sensitive circuit to activate battery when ac input falls to 75 percent of normal voltage and 15 minute time delay feature for areas with HID lighting. Provide integral self-testing module.

2.13 SELF-TESTING MODULE

Self-testing module for exit signs and emergency lighting equipment shall perform the following functions:

a. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.

b. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load.

c. Manual test switch to simulate a discharge test cycle.

d. Module shall have low voltage battery disconnect (LVD) and brown-out protection circuit.

2.14 CENTRAL EMERGENCY SYSTEM

Each system shall supply as indicated on shop drawings watts of emergency power at 277, 120 as indicated on shop drawings volts, 60 Hz sine wave ac, 32 as indicated on shop drawings volts dc, for a minimum period of 90 minutes. Sine wave ac system shall have an inverter output distortion of not more than 10 percent at unity power factor. The system shall be designed to handle surges during loss and recovery of power.

2.14.1 Operation

With normal power applied, batteries shall be automatically charged. Upon loss of normal power, system shall automatically disengage from the normal input line and switch to a self-contained inverter within 1 second when serving incandescent and fluorescent lamps, 2 milliseconds when serving HID lamps. Inverter shall have built-in protection when output is shorted or overloaded. When normal power resumes, the emergency system shall automatically switch back to normal operation before the power loss. Size transfer switch for this function to handle 125 percent of full load.

2.14.2 Battery Charger

Provide two-rate charger for lead-calcium batteries. Provide three-rate charger for nickel-cadmium batteries. The charger shall be solid-state, completely automatic, maintaining the batteries in a fully charged condition, and recharging the batteries to full capacity as specified in

UL 924.

2.14.3 Batteries

Batteries shall be sealed lead-calcium, nickel-cadmium type, shall operate unattended, and shall require no maintenance, including no additional water, for a period of not less than 10, 5 years.

2.14.4 Accessories

Provide visual indicators to indicate normal power, inverter power, and battery charger operation. Provide test switch to simulate power failure by interrupting the input line, battery voltage meter, load ammeter, automatic brown-out circuitry to switch to emergency power when input line voltage drops below 75 percent of normal value, electrolyte level detector that will activate a visual or audio alarm in the event of a low water condition, time delay feature for areas with HID lighting, and low voltage cutoff (LVD) to disconnect inverter when battery voltage drops to approximately 80 percent of nominal voltage.

2.14.5 Enclosure

Provide a free-standing cabinet with floor stand. Cabinet construction shall be of 14 gage sheet steel with baked-on enamel finish and locking type latch.

2.15 AUXILIARY INSTANT-ON SYSTEM

UL listed, automatically switched instant-on 150, 250 watt quartz, compact fluorescent lamp. Quartz, Compact fluorescent lamp shall come on when luminaire is initially energized and following a momentary power outage and shall remain on until HID lamp reaches approximately 60 percent light output. Wiring for quartz, compact fluorescent lamp shall be internal to the ballast and shall be independent of the incoming line voltage to the ballast. Provide instant-on quartz, compact fluorescent system for each HID fixture. Provide instant-on quartz, compact fluorescent system as indicated.

2.16 OCCUPANCY SENSORS

UL listed. Occupancy sensors and power packs shall be designed to operate on the voltage indicated. Sensors and power packs shall have circuitry that only allows load switching at or near zero current crossing of supply voltage. Occupancy sensor mounting as indicated. Sensor shall have an LED occupant detection indicator. Sensor shall have adjustable sensitivity and adjustable delayed-off time range of 5 minutes to 15 minutes, minimum. Wall mounted sensors shall be ivory, ceiling mounted sensors shall be white. Ceiling mounted sensors shall have 360 degree coverage unless otherwise indicated.

a. Ultrasonic sensor shall be crystal controlled and shall not cause detection interference between adjacent sensors.

b. Infrared sensors shall have a daylight filter. Sensor shall have a fresnel lens that is applicable for indicated usage.

c. Ultrasonic/Infrared Combination Sensor

Occupancy detection to turn lights on requires both ultrasonic and

infrared sensor detection. Lights shall remain on if either the ultrasonic or infrared sensor detects movement. Infrared sensor shall have lens selected for indicated usage and daylight filter to prevent short wavelength infrared interference. Ultrasonic sensor frequency shall be crystal controlled.

2.17 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.17.1 Wires

ASTM A 641/A 641M, galvanized regular coating, soft temper, 0.1055 inches in diameter (12 gage).

2.17.2 Wires, for Humid Spaces

ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel 0.1055 inches in diameter (12 gage).

ASTM B 164, UNS NO4400, annealed nickel-copper alloy 0.1055 inches in diameter (12 gage).

2.17.3 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A 653/A 653M, with a light commercial zinc coating or ASTM A 1008/A 1008M with an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

2.17.4 Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15 percent of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

3.1.2 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures shall be independently supported from the building structure by a minimum of four wires or straps, or rods per fixture and located near each corner of each

fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported from the building structure by a minimum of four wires or straps, or rods per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires or straps, or rods for lighting fixture support in this section. Lighting fixtures installed in suspended ceilings shall also comply with the requirements of Section 09 51 00, "Acoustical Ceilings."

3.1.3 Suspended Fixtures

Suspended fixtures shall be provided with 45 degree swivel hangers so that they hang plumb and shall be located with no obstructions within the 45 degree range in all directions. The stem, canopy and fixture shall be capable of 45 degree swing. Pendants, rods, or chains 4 feet or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degree separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 10 feet or as recommended by the manufacturer, whichever is less.

3.1.4 Ballasts

3.1.4.1 Remote Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp, as designated by the manufacturer.

3.1.4.2 Electronic Dimming Ballasts

All electronic dimming ballasts controlled by the same controller shall be of the same manufacturer. All fluorescent lamps on electronic dimming ballast control shall be seasoned or burned in at full light output for 100 hours before dimming.

3.1.5 Exit Signs and Emergency Lighting Units

Wire exit signs and emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.1.5.1 Exit Signs

Wire exit signs on separate circuits and serve from an emergency panel, a separate breaker, a fused disconnect switch. Signs shall have only one control, which shall be the circuit breaker in the emergency panel, the

separate breaker, the disconnect switch. Paint control device red and provide lockout.

3.1.5.2 Emergency Lighting from Central Emergency System

Wire emergency lighting powered from a central emergency system as indicated on the drawings.

3.1.6 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Set adjustable window slide for minimum footcandles photocell turn-on.

3.1.7 Occupancy Sensor

Provide quantity of sensor units indicated as a minimum. Provide additional units to give full coverage over controlled area. Full coverage shall provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways. Locate the sensor(s) as indicated and in accordance with the manufacturer's recommendations to maximize energy savings and to avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage. Set sensor "on" duration to 15 minutes.

3.1.8 Light Level Sensor

Locate light level sensor as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for 50 footcandles or for the indicated light level at the typical work plane for that area.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

3.2.1 Electronic Dimming Ballast

Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range.

3.2.2 Occupancy Sensor

Test sensors for proper operation. Observe for light control over entire area being covered.

-- End of Section --

SECTION 26 56 00

EXTERIOR LIGHTING

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS O5.1	(2002; Supple A 2003; Supple B 2003; Supple C 2004) Specifications and Dimensions (for Wood Poles)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS-4	(2006) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C136.20	(1990) Roadway Lighting Equipment Fiber Reinforced-Plastic (FRP) Lighting Poles
ANSI C136.21	(2004) Roadway Lighting Equipment - Vertical Tenons Used with Post-Top-Mounted Luminairesk

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C4	(2003) Poles - Preservative Treatment by Pressure Processes
AWPA M6	(1996) Brands Used on Forest Products

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 108	(2006) Standard Specification for

	Aluminum-Alloy Permanent Mold Castings
ASTM C 1089	(2006) Standard Specification for Spun Cast Prestressed Concrete Poles
ASTM E 2129	(2005) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM G 154	(2006) Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9	(2000; Errata 2004; Errata 2005) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2007) National Electrical Safety Code
IEEE Std 100	(2000) The Authoritave Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.41	(2006) Guidelines for Low-Pressure Sodium Lamps
NEMA C136.10	(2006) American National Standard for Roadway Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
NEMA C136.13	(2004) Roadway Lighting Equipment, Metal Brackets for Wood Poles
NEMA C136.3	(2005) Roadway and Area Lighting Equipment Luminaire Attachments
NEMA C78.1381	(1998) Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps
NEMA C78.42	(2004) Standard for High-Pressure Sodium Lamps
NEMA C78.43	(2007) Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
NEMA C82.4	(2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

NEMA ICS 2	(2000; Errata 2002; R 2005; Errata 2006) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 6	(1993; R 2006) Standard for Industrial Controls and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 345-67	(1998) REA Specification for Filled Telephone Cables, PE-39

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1029	(1994; Rev thru Dec 2007) Standard for Safety High-Intensity-Discharge Lamp Ballasts
UL 1598	(2004; Rev thru May 2006) Luminaires
UL 773	(1995; Rev thru Mar 2002) Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting
UL 773A	(2006) Nonindustrial Photoelectric Switches for Lighting Control

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Groundline section is that portion between one foot above and 2 feet below the groundline.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Luminaire drawings

Poles

SD-03 Product Data

Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

Energy Efficiency

Luminaires

Lamps

Ballasts

Lighting contactor

Time switch

Photocell switch

Concrete poles

Aluminum poles

Steel poles

Fiberglass poles

Brackets

Auxiliary instant-on quartz system

SD-04 Samples

Luminaires

Submit one sample of each luminaire type, complete with lamp and ballast. Submit one sample for each item other than luminaires. Sample will be returned to the Contractor for installation in the project work.

SD-05 Design Data

Design Data for luminaires

SD-06 Test Reports

Pressure treated wood pole quality

Tests for fiberglass poles

Operating test

Submit operating test results as stated in paragraph entitled "Field Quality Control."

SD-08 Manufacturer's Instructions

Concrete poles

Submit instructions prior to installation.

Fiberglass poles

Submit instructions prior to installation.

SD-10 Operation and Maintenance Data

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.4 QUALITY ASSURANCE

1.4.1 Drawing Requirements

1.4.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data shall accompany shop drawings.

1.4.1.2 Poles

Include dimensions, wind load determined in accordance with AASHTO LTS-4, pole deflection, pole class, and other applicable information. For concrete poles, include: section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes; initial prestressing steel tension; and concrete strengths at release and at 28 days.

1.4.2 Pressure Treated Wood Pole Quality

Ensure the quality of pressure treated wood poles. Furnish an inspection report (for wood poles) of an independent inspection agency, approved by the Contracting Officer, stating that offered products comply with AWPA M6 and RUS Bull 345-67 standards. The RUS approved Quality Mark "WQC" on each pole will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.3 Design Data for Luminaires

a. Distribution data according to IESNA classification type as defined in

IESNA HB-9.

b. Computerized horizontal illumination levels in footcandles at ground level, taken every 10, 20 feet. Include average maintained footcandle level and maximum and minimum ratio.

c. Amount of shielding on luminaires.

1.4.4 Tests for Fiberglass Poles

a. Ultraviolet resistance tests: Perform according to ASTM G 154 using a UV-B lamp having a 313 nanometer wavelength, operated at 130 degrees F, cycling the lamp on for 4 hours and off for 4 hours for a total test period of 1500 hours minimum with the following results:

Fiber exposure:	None
Crazing:	None
Checking:	None
Chalking:	None
Color:	May dull slightly

b. Flexural strength and deflection test: Test loading shall be as a cantilever beam with pole butt as fixed end and a force simulating wind load at the free end.

1.4.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.6 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.6.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.6.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Wood Poles

Stack poles stored for more than 2 weeks on decay-resisting skids arranged to support the poles without producing noticeable distortion. Store poles to permit free circulation of air; the bottom poles in the stack shall be at least one foot above ground level and growing vegetation. Do not permit decayed or decaying wood to remain underneath stored poles. Do not drag treated poles along the ground. Do not use pole tongs, cant hooks, and other pointed tools capable of producing indentation more than one inch in depth in handling the poles. Do not apply tools to the groundline section of any pole.

1.5.2 Concrete Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation.

1.5.3 Fiberglass Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.5.4 Aluminum, Steel Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.6.2 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: _____.

1.6.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit documentation for Energy Star qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render

satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POWER SOURCE

Use a photovoltaic power source.

1.9 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement, take-back program. Collect information from the manufacturer about maintenance agreement, green lease, options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 33 71 02.00 20 UNDERGROUND TRANSMISSION AND DISTRIBUTION, Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION, Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 26 51 00 INTERIOR LIGHTING.

2.2 LUMINAIRES

UL 1598. Provide luminaires as indicated. Provide luminaires complete with lamps of number, type, and wattage indicated. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar designs, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

2.2.1 Lamps

2.2.1.1 High-Pressure Sodium (HPS) Lamps

NEMA C78.42. Wattage as indicated. HPS lamps shall have average rated life of 16,000 hours (minimum) for 35 watt lamps and 24,000 hours (minimum) for all higher wattage lamps. 150 watt lamps, if required, shall be 55 volt lamps. Lamps shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0%

    1. 150-399 watts: minimum 58 LER for closed fixture; minimum 68 for open fixture

    2. 400-999 watts: minimum 63 LER for closed fixture; minimum 84 for open fixture

b. Upward efficiency of 1%-10%

    1. 150-399 watts: minimum 64 LER for closed fixture; minimum 63 for

open fixture

2. 400-999 watts: minimum 82 LER for closed fixture; minimum 89 for open fixture

3. 1000+ watts: minimum 109 LER for open fixture

c. Upward efficiency of 11% to 20%

1. 150-399 watts: minimum 78 LER for open fixture

2. 400-999 watts: minimum 94 for open fixture

d. Upward efficiency greater than 20%

1. 150-399 watts: minimum 75 LER for closed fixture; minimum 77 for open fixture

2.2.1.2 Standby HPS Lamps

NEMA C78.42. Wattage as indicated. Standby HPS lamps shall have two arc tubes and an average rated life of 40,000 hours (minimum). Hot restart instant lumen output shall be 8 percent, minimum, of total light output. 150 watt lamps, if required, shall be 55 volt type.

2.2.1.3 Low-Pressure Sodium (LPS) Lamps

NEMA ANSLG C78.41.

2.2.1.4 Metal-Halide Lamps

Provide luminaires with tempered glass lens.

a. Double-ended, 70 watt, conforming to NEMA C78.1381

b. Single-ended, wattage as indicated, conforming to NEMA C78.43

Lamps shall have Luminaire Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0%

1. 150-399 watts: minimum 41 LER for closed fixture

2. 400-999 watts: minimum 53 LER for closed fixture; minimum 59 for open fixture

3. 1000+ watts: minimum 77 LER for closed fixture

b. Upward efficiency of 1%-10%

1. 150-399 watts: minimum 56 LER for closed fixture

2. 400-999 watts: minimum 62 LER for closed fixture; minimum 64 for open fixture

3. 1000+ watts: minimum 88 LER for open fixture

c. Upward efficiency greater than 20%

1. 150-399 watts: minimum 62 LER for closed fixture; minimum 77 for open fixture

2. 400-999 watts: minimum 65 LER for closed fixture

2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaires

UL 1029 and NEMA C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type (minimum 90%). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on voltage system to which they are connected.

b. Constructed so that open circuit operation will not reduce the average life.

HID ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

2.3 LIGHTING CONTACTOR

NEMA ICS 2, electrically, mechanically held contactor. Contacts shall be rated as indicated on shop drawings. Coils shall be rated as indicated on shop drawings volts. Rate contactor as indicated. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor and shall require no arcing contacts. Provide contactor with hand-off-automatic, on-off, selector switch. Contactor shall be hermetically sealed.

2.4 TIME SWITCH

Astronomic dial type or electronic type, arranged to turn "ON" at sunset, and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated as indicated on shop drawings volts, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 3R, 1 enclosure conforming to NEMA ICS 6.

2.5 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated as indicted on drawings volts ac, 60 Hz with single-throw contacts, single pole double-throw (spdt) contacts for mechanically held contactors rated 1000 watts designed to fail to the ON position. Switch shall turn on at or below 3 footcandles and off at 4 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide switch:

a. In a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a fixture mounted, locking-type receptacle conforming to NEMA C136.10 and rated 1800 VA, minimum.

b. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

c. In a U.V. stabilized polycarbonate housing with swivel arm and adjustable window slide, rated 1800 VA, minimum.

d. Integral to the luminaire, rated 1000 VA, minimum.

2.6 POLES

Provide poles designed for wind loading of 100 miles per hour determined in accordance with AASHTO LTS-4 while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be embedded, anchor-base type designed for use with underground, overhead, supply conductors. Poles, other than wood poles, shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screws. Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole. Scratched, stained, chipped, or dented poles shall not be installed.

2.6.1 Concrete Poles

Provide concrete poles conforming to ASTM C 1089. Cross-sectional shape shall be round or multi-sided.

2.6.1.1 Steel Reinforcing

Prestressed concrete pole shafts shall be reinforced with steel prestressing members. Design shall provide internal longitudinal loading by either pretensioning or post tensioning of longitudinal reinforcing members.

2.6.1.2 Tensioned Reinforcing

Primary reinforcement steel used for a prestressed concrete pole shaft shall be tensioned between 60 to 70 percent of its ultimate strength. The amount of reinforcement shall be such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.

2.6.1.3 Coating and Sleeves for Reinforcing Members

Where minimum internal coverage cannot be maintained next to required core openings, such as handhole and wiring inlet, reinforcing shall be protected with a vaporproof noncorrosive sleeve over the length without the 1/2 inch concrete coverage. Each steel reinforcing member which is to be post-tensioned shall have a nonmigrating slipper coating applied prior to the addition of concrete to ensure uniformity of stress throughout the length of such member.

2.6.1.4 Strength Requirement

As an exception to the requirements of ASTM C 1089, poles shall be naturally cured to achieve a 28-day compressive strength of 7000 psi. Poles shall not be subjected to severe temperature changes during the curing period.

2.6.1.5 Shaft Preparation

Completed prestressed concrete pole shaft shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost, and shall be clean, smooth, and free of surface voids and internal honeycombing. Poles shall not be installed for at least 15 days after manufacture.

2.6.2 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS-4 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type with minimum 0.188 inch wall thickness. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Tops of shafts shall be fitted with a round or tapered cover. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B 108 and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded. Base cover shall be cast 356-T6 aluminum alloy in accordance with ASTM B 108. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel. Aluminum poles and brackets for walkway, lighting shall have a uniform satin, dark anodic bronze finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

2.6.3 Steel Poles

AASHTO LTS-4. Provide steel poles having minimum 11-gage steel with minimum yield/strength of 48,000 psi and hot-dipped galvanized in accordance with ASTM A 123/A 123M iron-oxide primed factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Pole shall be direct set, anchor bolt mounted type. Poles shall have tapered tubular members, either round in cross section or polygonal. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 3 to 4 feet above grade and shall include manufacturer, year of manufacture, top and bottom diameters, and length. Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 36,000 psi.

2.6.4 Wood Poles

ATIS O5.1 and RUS Bull 345-67 of Southern Yellow Pine, Douglas Fir. Poles shall be gained, bored, and roofed before treatment. Poles shall be treated full length with chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) according to AWPA C1 and AWPA C4 as referenced in RUS Bull 345-67. Poles shall be branded by manufacturer with manufacturer's mark and date of treatment, height and class of pole, wood species, preservation code, and retention. Place the brand so that the bottom of the brand or disc is 10 feet from the pole butt for poles up to 50 feet long and 14 feet from the butt for poles over 50 feet long.

2.6.5 Fiberglass Poles

ANSI C136.20. Designed specifically for supporting luminaires and having factory-formed cable entrance and handhole. Resin color shall be dark bronze, as indicated, and pigment shall provide uniform coloration throughout entire wall thickness. Finish surface shall be pigmented polyurethane having a minimum dry film thickness of 1.5 mils. Polyurethane may be omitted if the surface layer of the pole is inherently ultraviolet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

2.7 BRACKETS AND SUPPORTS

NEMA C136.3, NEMA C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1 1/4 inch galvanized steel pipe, aluminum secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

2.8 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the top 12 inches of the rod shall be galvanized in accordance with ASTM A 153/A 153M. Concrete shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.9 AUXILIARY INSTANT-ON QUARTZ SYSTEM

UL listed, automatically switched instant-on 150, 250-watt quartz lamp. Quartz lamp shall come on when the luminaire is initially energized and immediately after a momentary power outage, and remain on until HID lamp reaches approximately 60 percent light output. Wiring for quartz lamp shall be internal to ballast and independent of incoming line voltage to the ballast. Provide instant-on quartz system for each HID fixture. Provide instant-on quartz system as indicated.

2.10 EQUIPMENT IDENTIFICATION

2.10.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.10.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. Luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and

compact fluorescent luminaires.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

d. ANSI ballast type (M98, M57, etc.) for HID luminaires.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.11 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.1.1 Wood Poles

Pole holes shall be at least as large at the top as at the bottom and shall be large enough to provide 4 inches of clearance between the pole and the side of the hole.

a. Setting depth: Pole setting depths shall be as follows:

Length of Pole (feet)	Setting in Soil (feet)
20	5.0
25	5.5
30	5.5
35	6.0
40	6.0
45	6.5
50	7.0
55	7.5
60	8.0

b. Soil setting: "Setting in Soil" depths shall apply where pole holes are in soil, sand, or gravel or any combination of these. At corners, dead ends and other points of extra strain, poles 40 feet long or more shall be set 6 inches deeper.

c. Setting on sloping ground: On sloping ground, measure the depth of the hole from the low side of the hole.

d. Backfill: Tamp pole backfill for the full depth of the hole and mound the excess fill around the pole.

3.1.2 Concrete Poles

Install according to pole manufacturer's instructions.

3.1.3 Fiberglass Poles

Install according to pole manufacturer's instructions.

3.1.4 Aluminum, Steel Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 33 71 02.00 20 UNDERGROUND TRANSMISSION AND DISTRIBUTION, 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. After installation, paint exposed surfaces of steel poles with two finish coats of exterior oil paint of a color as indicated, aluminum paint.

3.1.5 Pole Setting

Depth shall be as indicated. Poles in straight runs shall be in a straight line. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6 inch maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

3.1.6 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Mount switch on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm. Set adjustable window slide for _____ footcandles photocell turn-on.

3.1.7 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 71 02.00 20 UNDERGROUND TRANSMISSION AND DISTRIBUTION, 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.1.8 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly

installed, connected, and adjusted. Conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

09/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA/EIA-606-A	(2002) Administration Standard for the Telecommunications Infrastructure

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

TIA/EIA-492AAAA-A	(1998) 62.5-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers (ANSI/TIA/EIA-492AAAA-A)
TIA/EIA-526-7	(1988) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant (ANSI/TIA/EIA-526-7)
TIA/EIA-568-B.1	(2001; Addendum 2001) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements (ANSI/TIA/EIA-568-B.1)
TIA/EIA-568-B.2	(2001) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components (ANSI/TIA/EIA-568-B.2)
TIA/EIA-568-B.3	(2000; Addendum 2002) Optical Fiber Cabling Components Standard (ANSI/TIA/EIA-568-B.3)
TIA/EIA-569-A	(1998; Addenda 2000, 2001) Commercial Building Standards for Telecommunications Pathways and Spaces (ANSI/TIA/EIA-569-A)
TIA J-STD-607-A	(2002) Commercial Building Grounding (Earthen) and Bonding Requirements for Telecommunications
EIA/TIA TSB-75	(1996) Additional Horizontal Cabling Practices for Open Offices

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	Standards Publication for Communications Wire and Cable for Wiring of Premises

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 63.1	(2000) Twisted Pair Premise Voice and Data Communications Cables

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007; AMD 1 2008) National Electrical Code - 2008 Edition

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS TECM 823	(1980) Electrical Protection by Use of Gas Tube Connectors

UNDERWRITERS LABORATORIES (UL)

UL 1666	(2000; Rev thru Jul 2002) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 1863	(2000) Communication Circuit Accessories
UL 444	(2002; Rev thru Aug 2002) Communications Cables
UL 467	(2007) Standard for Grounding and Bonding Equipment
UL 497	(2001) Protectors for Paired Conductor Communication Circuits
UL 1286	(1993; Bul. 1998, R 1998) Office Furnishings
UL 514C	(1996; R 2002) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 969	(1995; Rev thru Nov 2001) Marking and Labeling Systems

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods"; Section 26 20 00, "Interior Distribution System" and Section 33 82 00 "Telecommunications Outside Plant (OSP) apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Main Distribution Frame (MDF)

A physical structure at a central location for terminating permanent

backbone cables to interconnect with service provider (SP) equipment at the activity minimum point of presence. The MDF generally includes vendor specific components to support voice and data circuits, building surge protector assemblies, main cross connect blocks, equipment support frames, and wood backboard (if MDF is wall mounted). Depending upon local site conditions, the MDF and BDF may be identical.

1.3.2 Building Distribution Frame (BDF)

A structure with terminations for connecting backbone, campus, and horizontal cabling. The BDF generally includes a cross connect, equipment support frame, and wooden backboard or terminal cabinet. The BDF shall include building protector assemblies when used for campus backbone or SP cabling.

1.3.3 Intermediate Distribution Frame (IDF)

An intermediate termination point for horizontal wiring and cross-connections within telecommunications rooms or wiring closets.

1.3.4 Telecommunications Room

An enclosed space for telecommunications equipment, terminations, and cross-connect wiring for horizontal cabling, minimum size shall be 8' x 10'. Telecommunications Rooms should be centrally located unless multiple rooms are used. Access to Telecommunications Rooms should be from a common area such as a hallway and the door should swing out. Multiple Telecommunications Rooms are required if the usable floor space to be served exceeds 10,000 square feet, or the cable length between the horizontal cross-connect and the telecommunications outlet, including slack, exceeds 295 feet. Multiple telecommunications rooms will be connected by a minimum of two 75mm (3 inch) conduits. The minimum ceiling height will be eight and one half feet. The flooring shall be bare concrete instead of carpet or tile to reduce dust and static electricity. Two separately dedicated 20 amp double gang electrical outlets will be installed on the same wall as the backboard. There should not be an electrical panel within the telecommunications room. The lock on the door shall be keyed to a P4 key.

1.4 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C (32 to 140 degrees F) and in the range of 0 to 95 percent relative humidity, non-condensing. Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). If emergency power is available, consider connecting it to the HVAC system.

1.5 SYSTEM DESCRIPTION

The structured telecommunications pathway system shall include permanently installed horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, and raceway, and hardware for splicing, terminating, and interconnecting. The horizontal system includes the pathway between the telecommunications room and the work area telecommunications outlet. The horizontal system shall be suitable for star topology with the IDF at the center or hub of the star. The backbone pathway system includes intrabuilding and interbuilding inter-connecting pathway to provide connectivity between the MDF's, BDF's,

and IDF's. The backbone system shall be suitable for star topology with the MDF at the center or hub of the star.

1.6 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 "Submittal Procedures":

SD-02 Shop Drawings

Telecommunications drawings

Distribution frames

SD-03 Product Data

Telecommunications cabling (backbone and horizontal)

Patch panels

Telecommunications outlet/connector assemblies

Equipment support frame

Building protector assemblies

Connector blocks

Protector modules

SD-06 Test Reports

Telecommunications cabling testing

Factory reel tests

Furnish factory reel tests for optical fiber cables.

SD-07 Certificates

Contractor Qualifications

Manufacturer Qualifications

Test plan

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5

Submit operations and maintenance data in accordance with Section 01 78 23, Operation and Maintenance Data and as specified herein.

1.7 ADDITIONAL SUBMITTAL REQUIREMENTS

1.7.1 Telecommunications Drawings

Provide registered communications distribution designer (RCDD) approved drawings complete with wiring diagrams and details required to prove that

the distribution system shall properly support connectivity from the telecommunications equipment room to telecommunications work area outlets. Show the entrance facility and layout of cabling and pathway runs, cross connect points, MDF, BDF, IDF, grounding system, terminating block arrangements and type. Drawings shall depict final telecommunications cabling configuration, including location, color coding, gage, pair assignment, polarization, and terminating blocks layout at cross connect points and patch panels after telecommunications cable installation. Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, MDF's, BDF's, IDF's, and equipment rooms keyed to floor plans by room number. Mount the laminated schematic near the MDF as directed by the Contracting Officer. The Telecommunications Contractor will receive design approval from the Base Telephone Officer prior to installation.

1.7.2 Distribution Frames

Provide shop drawing showing layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks and equipment spaces and racks.

1.7.3 Qualifications

1.7.3.1 Minimum Contractor Qualifications

Prior to installation, submit data of provider's experience and qualifications. All work under this section shall be performed by and all equipment shall be provided by a certified Telecommunications Contractor, hereinafter referred to as the Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.

b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products.

c. All installers assigned to the installation of this system or any ofits components shall be Building Industry Consulting Services International (BICSI) Certified Cabling Installation Technicians, Installer Level 2, or have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. Include names and locations of two projects successfully completed using optical fiber and copper communications cabling systems. Include written certification from users that systems have performed satisfactorily for not less than 18 months. Include specific experience in installing and testing structured telecommunications distribution systems using optical fiber and Category 6 cabling systems.

1.7.3.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

1.7.4 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and optical fiber components and accessories 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.7.5 Additions to Operation and Maintenance Manuals

In addition to requirements of Data package 5 for the telecommunications cabling and pathway system, include the requirements of paragraph entitled "Telecommunications Drawings."

1.8 DELIVERY AND STORAGE

Provide protection from weather, moisture, dirt, dust, and other contaminants for telecommunications cabling and pathway equipment placed in storage.

PART 2 PRODUCTS

2.1 PATHWAYS (BACKBONE AND HORIZONTAL)

TIA/EIA-569-A. Pathway shall be conduit, cable tray, under floor duct, access floor, and wireway, installations. Provide grounding and bonding as required by TIA J-STD-607-A. Cable tray wiring shall comply with NFPA 70. All conduits entering the Telecommunications Room will be home run conduits and shall either extend up from the floor 3 to 4 inches or down from the ceiling 3 to 4 inches and will be bonded to the TMGB or TGB by a minimum number 6 green sheathed conductor. All penetrations will be sealed in accordance with code (fire-stopping). A minimum of two 3 inch conduits will be installed between the Main Telecommunications Room and any sub closets.

2.1.1 Work area Pathways

Comply with TIA/EIA-569-A, except 1 1/4 inch diameter conduit. System furniture pathways shall comply with UL 1286. Horizontal cabling for open offices shall comply with EIA/TIA TSB-75.

2.1.2 Pull Boxes

Construct of galvanized sheet steel with screw-fastened covers. Minimum size of boxes shall be not less than 5-inches wide by 5-inches in length by 2 7/8 inches deep for individual 1 1/4 inch diameter conduit; minimum size of boxes shall be not less than 42 inches wide by 66 inches long by 11 inches deep for 4-inch conduit. Provide pull boxes where length of conduit exceeds 100 feet or where there are more than two 90 degree bends, or equivalent. Align conduit ends on opposite side of pull boxes. Provide pull boxes in straight lengths of conduit; neither pull boxes nor conduit bodies shall be permitted in lieu of bends.

2.2 BENDS

Inside radius of 2 inches or less conduit bend shall be at least 6 times the internal diameter of conduit, more than 2 inches is 10 times.

2.3 TELECOMMUNICATIONS OUTLET BOXES

Telecommunications outlet boxes should be placed 6" to the left or right of

every electrical outlet box in workable office areas or any area that could be converted into workable office area such as storage closet; also any conference room should have one floor and one ceiling box. Boxes shall be standard type 5 inches square by 2 7/8 inches deep with 1-inch diameter side knock-outs, with a single gang plaster ring. Mount flush in finished walls at height indicated. Outlet boxes for wall-mounted telephones shall be 2 by 4 2 1/8 inches deep with 1 CAT6 cable terminated in a standard wall phone plate; mounted at 54 inches above finished floor for classrooms or open spaces shall be telecommunications floor boxes large enough to support a surge of users with proper cable management. Floor boxes should not be used in wet areas. Tele electric poles or furniture managed pathways fed from above the wet area should be used. Multi-user Telecommunications Outlet Assembly i.e. Multimedia Outlet Assemblies (MUTOA) should be placed where best suited for the furniture used in the room.

2.3.1 Telecommunications Cabling

Cabling shall be UL listed for the application and shall comply with TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3 and NFPA 70. Provide a labeling system for cabling as required by TIA/EIA-606-A and UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.3.1.1 Backbone Copper

ICEA S-80-576, TIA/EIA-568-B.1, TIA/EIA-568-B.2 and UL 444, copper backbone cable shall be solid conductor, 24 AWG, 100 ohm, 25-pair UTP (Unshielded twisted pair), NFPA 70 CMR rated formed into 25 pair binder groups covered with a thermoplastic jacket. NFPA 70 type CMP may be substituted for type CMR. Pair twist-lengths and frequency per unit length shall be determined by the manufacturer. A minimum of two conductor twists per foot is required. Color coding shall comply with industry standards for 25 pair cables. Cable shall be third party verified to comply with EIA/TIA Category 6 requirements. Two 4 pair 24 AWG Category 6 riser (CMR) rated cable will be installed between the MDF and each of the IDF's and terminated in the patch panel.

2.3.1.2 Backbone Optical Fiber

TIA/EIA-492AAAA-A, TIA/EIA-568-B.3, UL 1666, NFPA 70. Optical fiber cable shall be 62.5/125-um, 12-fiber single mode 81125 UM, terminated on ST type connectors, with a non-conductive optical fiber riser cable (OFNR) rating. Nonconductive optical fiber Plenum (OFNP) cable may be substituted for type nonconductive optical fiber riser cable (OFNR). The cable jacket shall be orange and yellow. Terminate in a rack mounted fiber distribution center with sufficient slack for maintenance operation typically 36 inches. Fiber should be run to each IDF from the MDF..

2.3.2 Horizontal Cabling

Comply with NFPA 70, NEMA WC 63.1, ICEA S-80-576 and performance characteristics in TIA/EIA-568-B.1.

2.3.2.1 Horizontal Copper

TIA/EIA-568-B.2, NFPA 70, UTP (unshielded twisted pair), 100 ohm. Provide four each individually twisted pair, 24 AWG conductors, Category 6 general purpose cable, with a white or gray PVC jacket for jack one and a blue PVC jacket for jack two. Plenum (CMP) or riser (CMR) cable may be substituted

for general purpose cable. If the cabling passes thru a plenum air space then plenum (CMP) rated cable is required.

2.3.2.2 Horizontal Optical Fiber

TIA/EIA-492AAAA-A, TIA/EIA-568-B.3, NFPA 70. Optical fiber cable shall be 62.5/125-um, 2-fiber multimode, rated nonconductive optical fiber cable (OFN). Plenum (OFNP) or riser (OFNR) cable may be substituted for general purpose cable. The cable jacket shall be orange and be of single jacket construction.

2.4 DISTRIBUTION FRAMES

Provide building distribution frames (BDF's), intermediate distribution frames (IDF's), and main distribution frames (MDF's) as shown on design drawings for terminating and cross connecting permanent cabling.

2.4.1 Equipment Support Frame

EIA-310-D.

a. Bracket, wall mounted, 8 gauge aluminum. Provide hinged bracket compatible with 482.6 mm panel mounting.

b. Rack, wall mounted, 16 gauge steel construction treated to resist corrosion. Shall be CPI 15320-724 or equivalent.

c. Racks, floor mounted modular type, 16 gauge steel construction treated to resist corrosion. Provide rack with vertical and horizontal cable management channels, top cable troughs and grounding lug. Rack shall be compatible with 482.6 mm panel mounting.

d. Cabinets should be sused in areas that are not secured. Cabinets shall be no smaller than 24 inches wide by 48 inches high by 30 inches deep, but can be as large as 7 feet high by 24 inches wide by 30 inches deep. All cabinets should be lockable (keyed to current base key) and large enough to support all telephone/data equipment required in the building, plus 25 percent spare. Dedicated electrical outlets should be installed within the cabinet. A backboard for mounting equipment is still needed when a cabinet is installed.

2.4.2 Building Protector Assemblies

Building protector assembly shall have connector blocks for connection to the exterior cable at full capacity.

2.4.2.1 Protector Modules

UL 497, RUS TECM 823, three-electrode gas tube or solid state type rated for the application. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.4.3 Connector Blocks

Insulation displacement type, punch down block for Category 6 and higher systems. Provide blocks for the number of backbone cables terminated on the

block plus 25 percent spare.

2.4.4 Patch Panels

Provide ports for the number of horizontal cables terminated on the panel plus 25 percent spare. Provide pre-connectorized Optical fiber and copper patch cords for patch panels. Provide patch cords with connectors specified. Patch cords shall meet minimum performance requirements specified in TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3 for cables and hardware specified.

2.4.4.1 Modular to Patch Panel

TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3. Panels shall be third party verified and shall comply with EIA/TIA Category 6 requirements. Panel shall be constructed of 2.2 mm minimum aluminum and shall be compatible with an EIA 482.6 mm equipment rack. Panel shall provide 48 non-keyed, RJ-45 ports. Patch panels shall terminate the building cabling on 110-style insulation displacement connectors and shall utilize a printed circuit board interface. The rear of each panel shall have incoming cable strain-relief and routing guides. Panels shall have each port factory numbered and be equipped with laminated plastic nameplates above each port.

2.4.4.2 Fiber Optic Patch Panel

Provide panel for maintenance and cross-connecting of optical fiber cables. Panel shall be constructed of 2.2 mm minimum aluminum and shall be compatible with EIA 482.6 mm equipment racks. Each panel terminating backbone fiber optic cable shall provide either 6 or 12 ST multimode adapters. Each panel terminating horizontal multi-mode fiber optic cable shall provide 6 multi-mode MTRJ type adapters. Adapters shall utilize metallic alignment sleeves. Provide dust cover for all unused adapters. The rear of each panel shall have a cable management tray a minimum of 203 mm deep with removable cover, incoming cable strain-relief and routing guides. Panels shall have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter.

2.5 TELECOMMUNICATIONS OUTLET BOXES

Standard type 5 inch square by 2 7/8 inch with a single gang plaster ring. Mount flush in finished walls at height indicated. Depth of boxes shall be large enough to allow manufacturer's recommended conductor bend radii for fiber, typically 2 7/8 inch.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.6.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68.5, TIA/EIA-568-B.1, and TIA/EIA-568-B.2. UTP Outlet/connectors shall be UL 1863 listed, non-keyed, 4-pair, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with EIA/TIA Category 6 requirements. Outlet/connectors provided for Category 6 UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a 110-style PC board connector, color-coded for both T568A and T568B wiring. Each jack shall be wired T568A as indicated. UTP outlet/connectors shall comply with TIA-455-21-A for 750 mating cycles.

2.6.2 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3; flush or oversized design constructed of high impact thermoplastic. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process.

2.6.3 Optical Fiber Distribution Panel

Wall or rack mounted optical fiber distribution panel (OFDP) shall be constructed of 2.2 mm minimum anodized aluminum. Panel shall be divided into two sections, distribution and user. Distribution section shall have strain relief, routing guides and shall be lockable, user section shall have a cover for patch cord protection. Each distribution panel shall provide 6 or 12 ST adapters. Adapters shall utilize metallic alignment sleeves. Provide dust covers for all adapters. User panels shall have MTRJ type connectors with dust covers.

2.7 BACKBOARDS

Provide void-free, interior grade plywood 3/4 inch thick as indicated. Backboards shall be fire rated, with the fire stamp visible, or covered with two coats of gray or a lighter color, nonconductive, fire-retardant paint. Boards should be installed 4' width by 8' height and cover at least one wall in the telecommunications room.

2.8 GROUNDING AND BONDING PRODUCTS

Comply with UL 467, TIA J-STD-607-A, and NFPA 70. Components shall be identified as required by TIA/EIA-606-A. Ground rods shall be in accordance with Section 16402N, "Interior Distribution System." The preferred ground for the Telephone Main Grounding Bus (TMGB) bar will be to the Main Distribution Panel (MDP). All grounding and bonding conductors within the Telecommunications room will be green sheathed copper conductor, either stranded or solid, and labeled as suitable for use as such and tagged "DO NOT REMOVE". The minimum size of the TMGB shall be no smaller than 4" by 10" by 1/4 inch thick.

2.9 FIRESTOPPING MATERIAL

Provide asbestos free fire stopping system capable of maintaining an effective barrier against flame and gases. System shall be UL listed and comply with ASTM E 814. Include UL system number UL listed print from manufacturer for each type of floor, wall, and ceiling penetration.

2.10 NAMEPLATES

Provide nameplates for equipment rooms and telecommunications rooms doors in accordance with schedule provided on drawings. Provide equipment nameplates in accordance with Section 26 00 00, "Basic Electrical Materials and Methods".

PART 3 EXECUTION

3.1 INSTALLATION

Telecommunications pathway systems, including the horizontal and backbone pathway systems, telecommunications outlet/connector assemblies, and

associated hardware shall be installed in accordance with TIA/EIA-568-A, TIA/EIA-569-A, NFPA 70, and UL standards as applicable. Metal raceway bases, covers, and dividers shall be bonded and grounded in accordance with TIA J-STD-607-A. Pathways shall be installed in accordance with the following minimum clearance distances of 1.2 meters(4 feet) from motors, generators, frequency converters, transformers, x-ray equipment or uninterruptible power system, 300 mm (12 in) from power conduits and cable systems, 125 mm (5 inches) from fluorescent or high frequency lighting system fixtures.

3.1.1 Cabling

Install Category 6 UTP and optical fiber telecommunications cabling and pathway system as detailed in TIA/EIA-568-B.1, TIA/EIA-568-B.2, and TIA/EIA-568-B.3. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not untwist Category 6 UTP cables more than 12 mm from the point of termination to maintain cable geometry. Provide service loop on each end of the cable, 3 meters in the telecommunications closet, 1 meter in the work area outlet for optical fiber and 150 mm (6 inch) for UTP. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 110 Newton pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. Only Velcro type cable straps are allowed on Category 6 cable and optical fiber cable. For UTP cable bend radii shall not be less than four times the cable diameter.

3.1.1.1 Backbone Cable

a. Copper Backbone Cable. Install backbone copper cable between MDF, BDF, and IDF equipment as indicated on drawings.

b. Optical fiber Backbone Cable. Install backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 250 mm leaving strength members exposed for approximately 250 mm. Twist strength members together and attach to pulling eye. Vertical cable support intervals shall be in accordance with Manufacturer's recommendations.

3.1.1.2 Horizontal Cabling

Install horizontal cabling and pathway as indicated on drawings between MDF, BDF, IDF, and telecommunications outlet assemblies at workstations.

3.1.2 Pathway Installations

Comply with TIA/EIA-569-A, except 1 1/4 inch diameter conduit to each outlet from telecommunication room backboard. Conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 150 mm (6 inches) away from parallel runs of electrical power equipment, flues, steam, and hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit is visible after completion of project. Run conduits in crawl spaces and under floor slabs as if exposed. Install no more than two 1.57 radii (90 degree) bends for a single horizontal cable run. All bends/turns in conduits will be in straight runs

of conduit; in no case will a turn be made within a pull box. The minimum size for a pull box in a one inch home run conduit will be 5" long by 5" wide by 3" deep, and for a four inch conduit 60" long by 12" wide by 12" deep.

3.1.2.1 Service Entrance Conduit, Underground

PVC Type EPC-40, galvanized rigid steel, or steel IMC. Underground portion shall be encased in minimum of 75 mm (3 inches) of concrete extending from the building entrance to 1500 mm (5 feet) out from the building and shall be a minimum of 450 mm (18 inches) below slab or grade.

3.1.2.2 Work Area Outlets

All work area faceplates will contain four category 6 jacks.

3.1.2.3 Terminations

Terminate UTP cable in accordance with TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3 and wiring configuration as specified, T568A.

3.1.2.4 Faceplates

As a minimum, each jack shall have manufacture labels numbered and be equipped with laminated plastic cover over the label. Also, it shall be labeled as to its function with a blue computer icon on all even ports and a red phone icon on all the odd ports. (For secured networks, contact AHJ).

3.1.3 Cables

Unshielded twisted pair shall have a minimum of 152 mm (6 inch) slack cable and fiber optic cables shall have a minimum of 1 m of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.3.1 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have cable installed.

3.1.3.2 Telecommunications Room Termination

Install termination hardware required for Category 6 and optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.4 Equipment Support Frame

Install in accordance with TIA/EIA-569-A:

a. Bracket, wall mounted. Mount bracket to plywood backboard per manufacturer's recommendations. Mount rack so height of highest panel does not exceed 1980 mm (76 inches) above floor.

b. Racks, floor mounted modular type. Permanently anchor rack to the floor per manufacturer's recommendations.

3.1.5 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings.

3.1.6 Grounding and Bonding

Will be conducted in accordance with TIA J-STD-607-A, and NFPA 70.

3.1.7 Fire Stopping

Seal openings around raceway penetrations through fire resistance rated walls, partitions, floors and ceiling utilizing proper fire stopping materials to maintain fire resistive integrity.

3.2 LABELING

3.2.1 Labels

All labels shall be in accordance with TIA/EIA-606-A. The jacks will be numbered in a logical, sequential, clockwise numbering system.

3.2.2 Cable

All cables shall be labeled using color labels on both ends with encoded identifiers per TIA/EIA-606-A.

3.2.3 Termination Hardware

All workstation outlets and patch panel connections shall be labeled using color coded labels with encoded identifiers as per TIA/EIA-606-A.

3.3 TESTING

3.3.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3.

3.3.1.1 Inspection

Visually inspect cabling jacket materials for UL or third party certification markings. Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for tip and ring pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1, TIA/EIA-568-B.2, and TIA/EIA-568-B.3. Visually confirm Category 6 marking of outlets, wallplates, outlet/ connectors, and patch panels.

3.3.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connected. Perform 100 MHz near-end-cross-talk (NEXT) and attenuation tests for Category 6 systems installations. Perform optical fiber end to

end attenuation tests using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures.

Perform tests in accordance with TIA/EIA-526-14-A, Method B for horizontal, multimode optical fiber and TIA/EIA-526-7, Method B for backbone, single mode optical fiber. Perform verification acceptance tests and factory reel tests.

3.3.1.3 Performance Tests

a. Category 6 Links. Perform UTP link tests in accordance with TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3. Tests shall include wire map, length, attenuation, NEXT, and propagation delay.

b. Optical Fiber Links. Perform optical fiber end-to-end attenuation tests and reel tests at jobsite.

c. As built drawings showing all telecommunications outlets and their numbers.

3.3.1.4 Final Verification Tests

Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call. The final QC and certification of installation will be performed by Base Telephone after the contractor has provided the test results to the government contract representative.

3.3.1.5 Records

a. Records to be provided for copper shall include the cable specification sheets from the manufacturer, the cable routing and locations, all splice point locations, patch panel and jack locations, cable length, cable reel numbers and installation location, the test results in both hard copy and electronic version.

b. Records to be provided for fiber shall include the cable specification sheets from the manufacturer, the cable routing and locations, all splice point locations, patch panel and jack locations, cable length, cable reel numbers and installation location, the test
results in both hard copy and electronic version.

c. As built drawings showing all telecommunications outlets and their numbers.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND	METRIC

Outlet Boxes

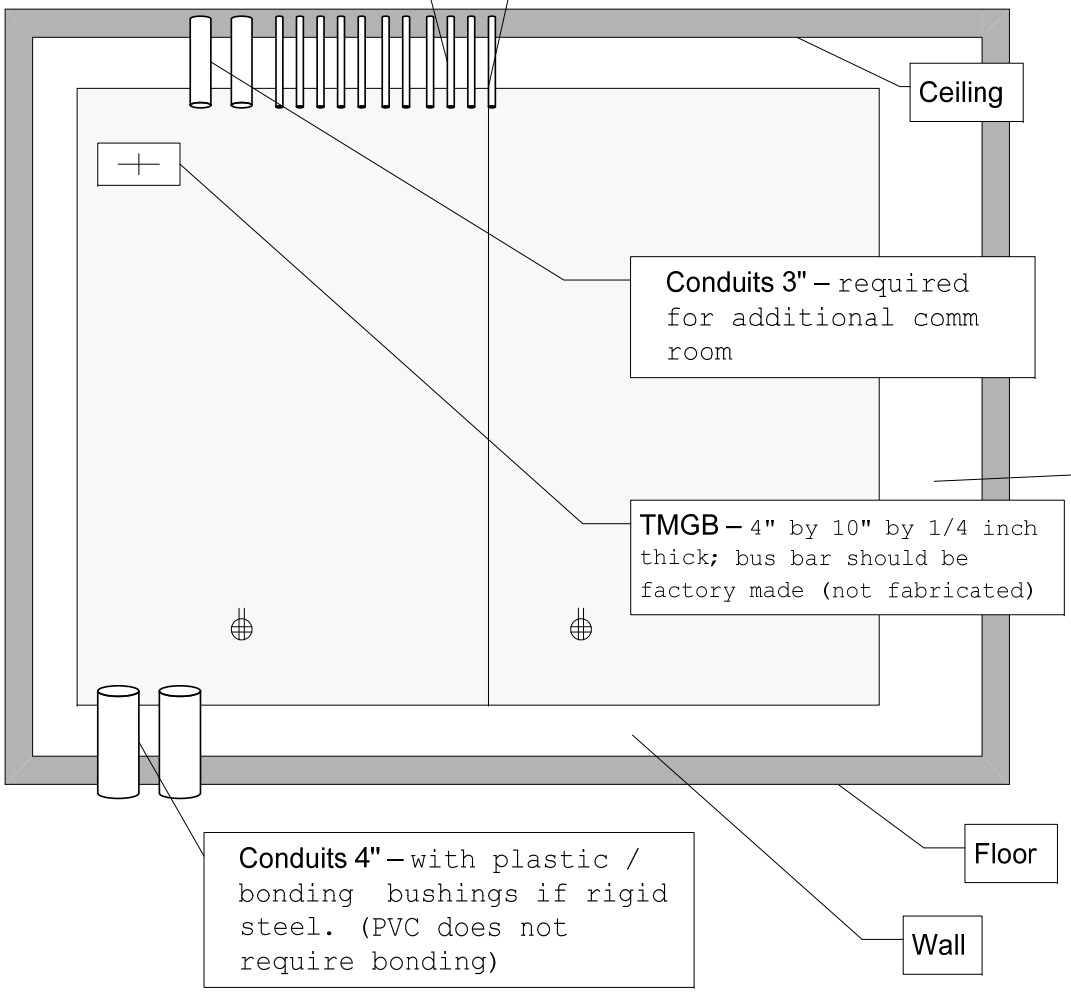
1. Standard		
- Length/width	5 inches (square)	127 mm (square)
- Depth	2 1/8 inches	55 mm
2. Telephone Outlet		
- Length	4 inches	100 mm
- Width	2 inches	50 mm
- Depth	2 1/8 inches	55 mm
- Depth	1 1/2 inches	38 mm

-- End of Section --

Telecommunications Backboard Example

Conduits 1" – with plastic / bonding bushings - home run to work area outlet or cable tray.

Telephone backboard - 4'x8' Provide min 2 void-free, interior grade plywood 19 mm (3/4 inch) thick as indicated. Backboards shall be fire rated, with the fire stamp visible or covered with two coats of gray or a lighter color nonconductive fire-retardant paint on all sides. Boards should be installed 4′ Width x 8′ Height securely fastened to the wall anywhere equipment is to be mounted.



General notes

-all metalic conduit and equipment must be bonded to the TMGB and building ground per TIA J-STD-607-A with min #6AWG stranded green sheath conductor.

-all conduits need to be securely mounted, fire stopped, and over lap the back board by 3-6".

-1 dedicated 20 amp quad power is required per comm. rack/cabinet.

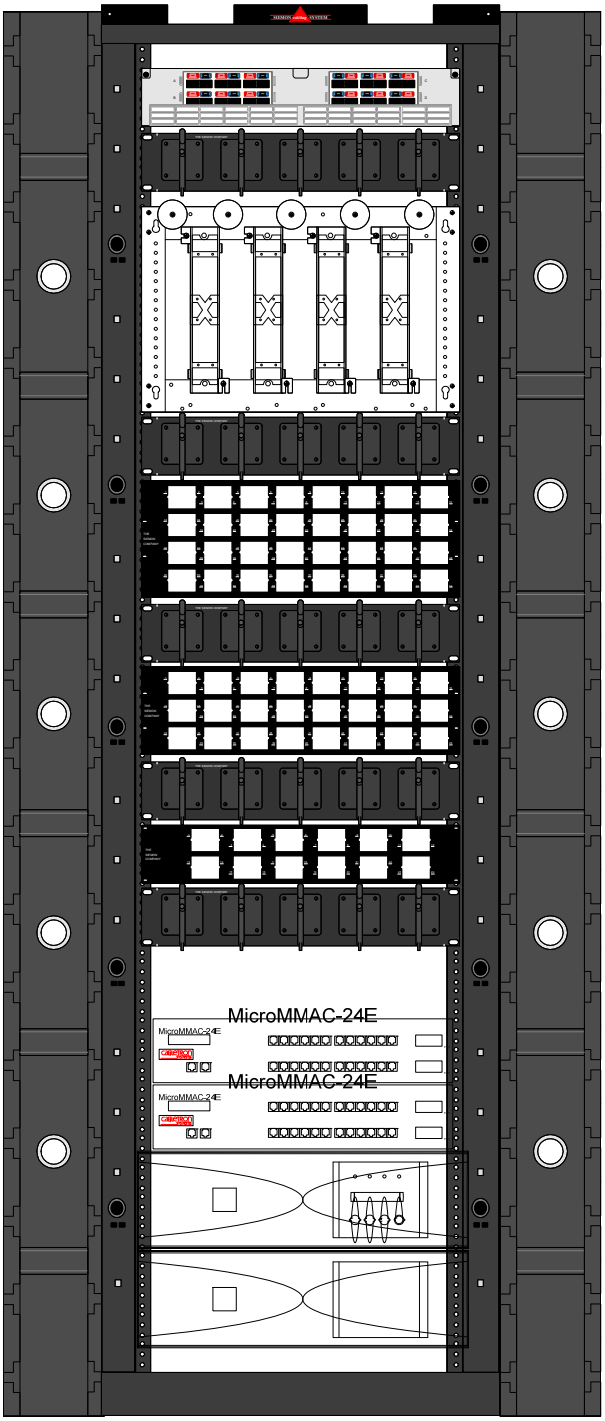
-If wired by base telephone; contractor should install all except the below and add pull strings in conduits.

-if wired by contractor; install 4 CAT5E/6A cables in each 1" conduit to typical work area outlet; also install all ladder racks, patch panels, cabinets, building protectors, OSP cable, riser cable, and equipment IAW Base Tele 27 10 00 .

NOT to Scale for reference only

On Backboard – PROTECTOR / BUILDING ENTRANCE BEP, TMGB,
Proper Bonding & grounding, Cable management / slack on ladder rack

RS3-07-S Rack or
T1030-712 Cabinet if in unsecure area



PCH-0XU
ST connectors

FIBER
Distribution

CABLE MANAGER
WM-145-5

CC-2014-TS-DC
KRONE' BLOCKS
6652-1-880-10

COPPER

CABLE MANAGER
WM-145-5
CT-PNL-64
CT-F-C5-C5-01
WM-BK

Number of telecommunications work outlets determine number and size of patch panel and need for additional racks

CABLE MANAGER
WM-145-5
CT-PNL-48
CT-F-C5-C5-01
WM-BK

If more than 3 racks are used: place the NMCI switch / cable termination rack towards the center

CABLE MANAGER
WM-145-5
CT-PNL-24
CT-F-C5-C5-01
WM-BK

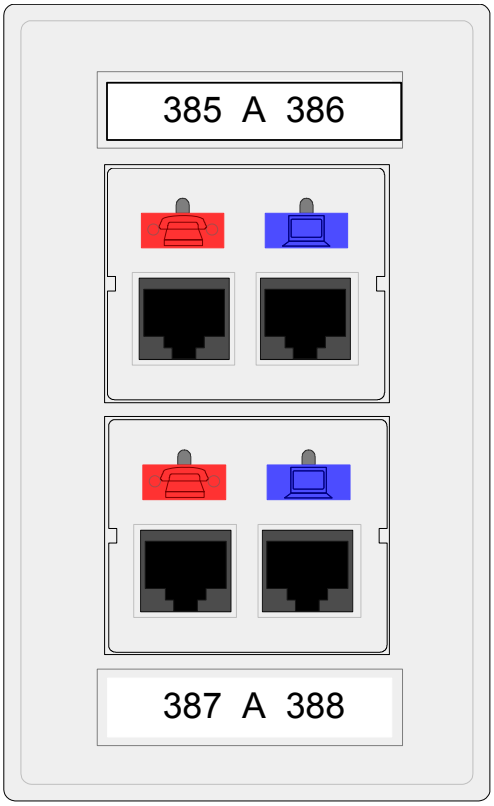
CABLE MANAGER
WM-145-5

TELECOMMUNICATIONS INFRASTRUCTURE STANDARDS MARINE CORPS BASE CAMP LEJEUNE

Bottom 15 RU is reserved for DATA equipment

SECTION 27 10 00
Encl A
RACK ELEVATION
EXAMPLE

Part #s shown are indicative of supplies/materials currently used by Base Telephone. However, equivalent parts/components from another manufacturer/vendor are acceptable for this project.



CT-FP-LBL-104

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FOR COPPER ONLY TO THE FACEPLATE

TELECOMMUNICATIONS INFRASTRUCTURE STANDARDS MARINE CORPS BASE CAMP LEJEUNE

SECTION 27 10 00
Encl C
FACEPLATE EXAMPLE

Part #s shown are indicative of supplies/materials currently used by Base Telephone. However, equivalent parts/components from another manufacturer/vendor are acceptable for this project.

SECTION 28 31 63.00 20

ANALOG/ADDRESSABLE INTERIOR FIRE ALARM SYSTEM

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME A17.1	(2007) Safety Code for Elevators and Escalators

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(2005) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2005; Errata 2006; TIA 2006; TIA 2006) Life Safety Code, 2006 Edition
NFPA 241	(2004) Safeguarding Construction,Alteration, and Demolition Operations
NFPA 72	(2006) National Fire Alarm Code
NFPA 90A	(2002; Errata 2003; Errata 2005) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 90	Private Land Mobile Radio Services

UNDERWRITERS LABORATORIES (UL)

UL 1971	(2002; Rev thru May 2006) Signaling Devices for the Hearing Impaired

UL 228	(2006) Door Closers-Holders, With or Without Integral Smoke Detectors
UL 268	(2006) Standard for Smoke Detectors for Fire Alarm Signaling Systems
UL 464	(2003; Rev thru Oct 2003) Standard for Audible Signal Appliances
UL 864	(2003; Rev thru May 2007) Control Units and Accessories for Fire Alarm Systems
UL Electrical Constructn	(2007) Electrical Construction Equipment Directory
UL Fire Prot Dir	(2007) Fire Protection Equipment Directory

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.3 DESCRIPTION OF WORK

1.3.1 Scope

This work includes designing and providing a new, complete, and modifying the existing analog/addressable fire alarm system as described herein and on the contract drawings for the Building name. The system shall include wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm, and supervisory signal initiating devices, alarm notification appliances, supervising station fire alarm system transmitter, and other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. Provide systems complete and ready for operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 72 except as modified herein. The system layout on the drawings show the intent of coverage and are shown in suggested locations. Final quantity, layout, and coordination is the responsibility of the Contractor. A single fire alarm control panel is indicated with terminal cabinets at each floor at each riser location. Where remote fire alarm control units are needed, they shall be provided at a terminal cabinet location. Each remote fire alarm control unit shall be powered from a wiring riser specifically for that use or from a local emergency power panel located on the same floor as the remote fire alarm control unit. Where remote fire control units are provided, equipment for notification appliances may be located in the remote fire alarm control units.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Provide six complete sets of submittals. Partial submittals will not be acceptable and will be returned without review. The Engineering Field Activity (EFA), Naval Facilities Engineering Command, Fire Protection Engineer, will review and approve submittals.

SD-02 Shop Drawings

Provide point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems which are supervised or controlled by the system. Diagrams shall show connections from field devices to the FACP and remote fire alarm control units, initiating circuits, switches, relays and terminals.

Provide plan view drawing showing device locations, terminal cabinet locations, junction boxes, other related equipment, conduit routing, wire counts, circuit identification in each conduit, and circuit layouts for all floors.

Provide a complete description of the system operation in matrix format on the drawings.

Provide a complete list of device addresses and corresponding messages.

Provide detailed drawings of the graphic annunciator.

Include annotated catalog data, in table format on the drawings, showing manufacturer's name, model, voltage, and catalog numbers for equipment and components.

Provide complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring. Include floor plans showing the locations of devices and equipment.

Battery power calculations

Submit shop drawings not smaller than 24 by 36 inches. As a minimum, the shop drawing submittal shall include the items listed above.

SD-03 Product Data

Fire alarm control panel (FACP)

Printers, covers, console rack, video display unit (VDU), etc.

Terminal cabinets/assemblies

Manual stations

Transmitters (including housing)

Batteries

Battery chargers

Smoke sensors

Thermal sensors

Wiring and cable

Notification appliances

Addressable interface devices

Graphic annunciator

Amplifiers

Tone generators

Digitalized voice generators

Firefighter telephone

Waterflow detectors

Tamper switches

Electromagnetic door holders

Remote fire alarm control units

Smoke sensor testing procedures

Radio transmitter and interface panels

Digital alarm communicator transmitter (DACT)

Telegraphic transmitter

Submit data on proposed equipment, including, but not limited to the items listed above. Include UL or FM listing cards for equipment provided.

SD-06 Test Reports

Furnish preliminary test results to the Contracting Officer. Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include printer information.

SD-07 Certificates

Qualifications of installer

SD-10 Operation and Maintenance Data

INTERIOR FIRE ALARM SYSTEM, Data Package 5

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Record drawing software

SD-11 Closeout Submittals

Prepare and submit to the Contracting Officer six sets of detailed as-built drawings. The drawings shall include complete wiring diagrams showing connections between devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as-built location of devices and equipment. The drawings shall show the system as installed, including deviations from both the project drawings and the approved shop drawings. The drawings shall be prepared on uniform sized mylar sheets not less than 30 by 42 inches with 8 by 4 inch title block similar to contract drawings. These drawings shall be submitted within 2 weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings shall be provided at the time of, or prior to the final acceptance test.

Submit the installer's training history for the employees involved with this contract.

1.5 ADDITIONAL SUBMITTAL REQUIREMENTS

1.5.1 Battery Power Calculations

Verify that battery capacity exceeds supervisory and alarm power requirements.

a. Provide complete battery calculations for both the alarm and supervisory power requirements. Ampere hour requirements for each system component shall be submitted with the calculations.

b. Provide data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances, 25, 50 percent spare capacity for initiating devices. Annotate data for each circuit on the drawings.

c. Provide data to indicate that the amplifiers have sufficient capacity to simultaneously drive fire alarm speakers at their 1/2 watt tap plus 50 percent spare capacity. Annotate data for each circuit on the drawings.

d. Provide a detailed description of the final acceptance testing procedures (including equipment nencessary for testing smoke detectors using real smoke).

1.5.2 Qualifications of Installer

Design shall be by a National Institute for Certification in Engineering Technologies (NICET) Level III or Level IV Technician. Installer shall have an office, which has been in existence for at least 3 years, within a 100 mile radius of the job site. Installation shall be accomplished by an electrical contractor with a minimum of 5 years' experience in the installation of fire alarm systems. The Contracting Officer may reject any proposed installer who cannot show evidence of such qualifications. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustments, and tests of the system. The Contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization which carries a stock of repair parts for the system to be furnished. The Contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the Contracting Officer and the receipt of

as-built drawings and schematics of all equipment. Prior to installation, submit data for approval by the Naval Facilities Engineering Command, Fire Protection Engineer, showing that the Contractor has successfully installed addressable, analog intelligent interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least three installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

1.5.3 Record Drawing Software

Furnish one set of floppy diskettes containing CAD based drawings in DXF format of as-built drawings and schematics.

1.6 QUALITY ASSURANCE

Equipment and devices shall be compatible and operable with existing station fire alarm system and shall not impair reliability or operational functions of existing supervising station fire alarm system.

1.6.1 Regulatory Requirements

Devices and equipment for fire alarm service shall be listed by UL Fire Prot Dir or approved by FM P7825.

1.6.1.1 Requirements for Fire Protection Service

Equipment and material shall have been tested by UL and listed in UL Fire Prot Dir or approved by FM and listed in FM P7825. Where the terms "listed" or "approved" appear in this specification, they shall mean listed in UL Fire Prot Dir or FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

1.6.1.2 Testing Services or Laboratories

Fire alarm and fire detection equipment shall be constructed in accordance with UL Fire Prot Dir, UL Electrical Constructn, or FM P7825.

1.6.2 Standard Products

Provide materials, equipment, and devices that have been tested by a nationally recognized testing laboratory, such as UL or FM, and listed or approved for fire protection service when so required by NFPA 72 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials.

1.6.3 Modification of References

a. In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; interpret reference to "authority having jurisdiction" to mean the Naval Facilities Engineering Command, Fire Protection Engineer.

b. The recommended practices stated in the manufacturer's literature or documentation shall be considered as mandatory requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants.

1.8 SPARE PARTS AND TOOLS

1.8.1 Interchangeable Parts

Spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the Contracting Officer at the time of the final acceptance testing.

1.8.2 Spare Parts

Furnish the following spare parts and accessories:

a. 4 audiovisual devices of each type installed

b. 4 fuses for each fused circuit

c. 1 electromagnetic door holders

d. 1 manual stations

e. 9 spare reams of paper for the system printer, plus sufficient paper for fire alarm acceptance tests

f. 2 smoke sensors and base of each type installed

g. 2 heat sensors and base of each type installed

h. 3 spare printer ribbons

i. 3 test magnets/devices for each type of sensors installed

j. 3 break rods for manual stations

1.8.3 Parts List

Furnish a list, in duplicate, of all other parts and accessories which the manufacturer of the system recommends to be stocked for maintenance.

1.9 KEYS

Keys and locks for equipment shall be identical. Provide not less than six keys of each type required. Keys shall be CAT 60.

PART 2 PRODUCTS

2.1 EXISTING FIRE ALARM EQUIPMENT

Existing fire alarm equipment shall be maintained fully operational until

the new equipment has been tested and accepted by the Contracting Officer. As new equipment is installed, it shall be labeled "NOT IN SERVICE" until the new equipment is accepted. Once the new system is completed, tested, and accepted by the Government, it shall be placed in service and connected to the station fire alarm system. New equipment shall have tags removed and the existing equipment shall be tagged "NOT IN SERVICE" until removed from the building.

2.1.1 Equipment Removal

After acceptance of the new system by the Contracting Officer, existing equipment not connected to the new system shall be removed, unused exposed conduit shall be removed, and damaged surfaces shall be restored. The material shall be removed from the site and disposed of by the Contractor.

2.1.2 Repair Service/Replacement Parts

Repair services and replacement parts for the system furnished under this contract shall be be available for a period of 10 years after the date of final acceptance of this work by the Contracting Officer. On-site service during the guarantee period shall be provided within 24 hours after notification. All repairs shall be completed within 48 hours after notification.

2.1.3 Other Divisions To Be Coordinated With

Refer to the following sections for related work and coordination:

Section 21 13 00.00 20 WET PIPE FIRE SUPPRESSION SPRINKLERS, Section 21 30 00 FIRE PUMPS, Section 21 23 00.00 20 WET DRY CHEMICAL FIRE EXTINGUISHING SYSTEMS, Section 21 13 16.00 20 DRY PIPE FIRE SUPPRESSION SPRINKLERS, Section 21 13 19.00 20 DELUGE PREACTION FIRE SUPPRESSION SPRINKLERS, Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS.

Section 08 71 00 DOOR HARDWARE for door release, door unlocking and additional work related to finish hardware.

Sections 14 21 00.00 20 ELECTRIC TRACTION ELEVATORS, 14 21 13 ELECTRIC TRACTION FREIGHT ELEVATORS, 14 21 23 ELECTRIC TRACTION PASSENGER ELEVATORS, 14 24 00 HYDRAULIC ELEVATORS for additional work related to elevators.

Section 07 84 00 FIRESTOPPING for additional work related to firestopping.

2.1.4 Manufacturer Qualifications

Components shall be of current design and shall be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as otherwise or additionally specified herein.

2.2 INTERIOR FIRE ALARM SYSTEM DESIGN

2.2.1 Definitions

Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions shall be defined as follows:

a. Analog/Addressable System: A system in which multiple signals are

transmitted via the same conduction path to a remote fire alarm control unit and fire alarm control panel, decoded and separated so that each signal will initiate the specified response.

b. Hard Wired System: A system in which alarm and supervisory initiating devices are directly connected, through individual dedicated conductors, to a central control panel without the use of analog/addressable circuits or devices.

c. Interface Device: An addressable device which interconnects hard wired systems or devices to an analog/addressable system.

d. Fire Alarm Control Unit: A control panel, remote from the fire alarm control panel, that receives inputs from automatic and manual fire alarm devices; may supply power to detection devices and interface devices; may provide transfer of power to the notification appliances; may provide transfer of condition to relays or devices connected to the control unit; and reports to and receives signals from the fire alarm control panel.

e. Fire Alarm Control Panel (FACP): A master control panel having the features of a fire alarm control unit and to which fire alarm control units are interconnected. The panel has central processing, memory, input and output terminals, video display units (VDUs), and printers.

f. Terminal Cabinet: A steel cabinet with locking, hinge-mounted door in which terminal strips are securely mounted.

2.2.2 System Operation

The system shall be a complete, supervised, noncoded, analog/addressable fire alarm system conforming to NFPA 72. The system shall have an interconnected riser loop or network having Style 6 supervision that shall not be located in the same room or shaft. The return portion of the loop shall be remote from the supply portion of the loop. Where the building has two stairs for egress from floors above grade, a single impairment cannot adversely affect more than one floor. Where three or more stairs are provided for egress from floors above grade, a single impairment cannot adversely affect more than 1/2 of any floor. Any single impairment of the system shall not affect the system on more than one, one-half of any floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal. The system shall provide the following functions and operating features:

a. The FACP and fire alarm control units, if used, shall provide power, annunciation, supervision, and control for the system.

b. Provide Style B initiating device circuits for conductor lengths of 10 feet or less.

c. Provide Style 4 signaling line circuits for each floor.

d. Provide Style 6 signaling line circuits for the network.

e. Provide Style Z notification appliance circuits. The visual alarm notification appliances shall have the flash rates

synchronized.

f. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.

g. Provide an audible and visual trouble signal to activate upon a single break or open condition, or ground fault. The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature which shall silence the audible trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions, the trouble signal shall again sound until the trouble is acknowledged. A smoke sensor in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.

h. Provide a notification appliance silencing switch which, when activated, will silence the audible signal appliance, but will not affect the visual alarm indicator, the liquid crystal display, or the automatic notification of the fire department, central station service. This switch shall be overridden upon activation of a subsequent alarm.

i. Provide alarm verification capability for smoke sensors. Alarm verification shall initially be set for 30 seconds.

j. Provide program capability via switches in a locked portion of the FACP to bypass the automatic notification appliance circuits, fire reporting system, air handler shutdown, smoke control operation, elevator recall, door release, door unlocking, features. Operation of this programming shall indicate this action on the FACP display and printer output.

k. Alarm, supervisory, and/or trouble signals shall be automatically transmitted to the fire department, a UL listed central station.

l. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.

m. The system shall be capable of being programmed from the panel's keyboard. Programmed information shall be stored in non-volatile memory.

n. The system shall be capable of operating, supervising, and/or monitoring both addressable and non-addressable alarm and supervisory devices.

o. There shall be no limit, other than maximum system capacity, as to the number of addressable devices which may be in alarm simultaneously.

p. Where the fire alarm system is responsible for initiating an action in another emergency control device or system, such as an HVAC system, an atrium exhaust system, a smoke control system, an elevator system, the addressable fire alarm relay shall be within 3 feet of the emergency control device.

q. An alarm signal shall automatically initiate the following functions:

(1) Transmission of an alarm signal to the fire department, a UL listed central station.

(2) Visual indication of the device operated on the fire alarm control panel (FACP), video display unit (VDU), and on the graphic annunciator. Indication on the graphic annunciator shall be by floor, zone or circuit, and type of device.

(3) Continuous actuation of all alarm notification appliances, except those in stairs or in elevator cabs. Continuous actuation of alarm notification appliances on the floor of fire alarm origin, the floor above the floor of fire alarm origin, and the floor below the floor of fire alarm origin, except those in stairs or in elevator cabs.

(4) Recording of the event via the system printer.

(5) Release of doors held open by electromagnetic devices.

(6) Operation of the smoke control system, atrium exhaust system.

(7) Release of power to electric locks on doors which are part of the means of egress.

(8) Operation of a smoke sensor in an elevator lobby or other location associated with the automatic recall of elevators, shall recall the elevators in addition to other requirements of this paragraph.

(9) Operation of a duct smoke sensor shall shut down the appropriate air handler in accordance with NFPA 90A in addition to other requirements of this paragraph.

(10) Operation of _____ shall release the _____ fire extinguishing system after a _____ second time delay.

(11) Operation of a sprinkler waterflow switch serving an elevator machinery room shall operate shunt trip circuit breaker(s) to shut down power to the elevators in accordance with ASME A17.1.

(12) Operation of an interface, which operates vibrating pagers worn by hearing-impaired occupants.

r. A supervisory signal shall automatically initiate the following functions:

(1) Visual indication of the device operated on the FACP, VDU, and on the graphic annunciator, and sound the audible alarm at the respective panel.

(2) Transmission of a supervisory signal to the fire department a UL listed central station.

(3) Recording of the event via the system printer.

s. A trouble condition shall automatically initiate the following functions:

(1) Visual indication of the system trouble on the FACP, VDU, and on the graphic annunciator, and sound the audible alarm at the respective panel.

(2) Transmission of a trouble signal to the fire department a UL listed central station.

(3) Recording of the event via the system printer.

t. The maximum permissible elapsed time between the actuation of an initiating device and its indication at the FACP shall be 15 seconds.

u. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP shall not exceed 200 seconds.

2.2.3 System Monitoring

a. Valves: Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, standpipe control valves, sprinkler service entrance valve, valves at fire pumps, and valves at backflow preventers, whether supplied under this contract or existing, shall be electrically monitored to ensure its proper position. Each tamper switch shall be provided with a separate address, unless they are within the same room, then a maximum of 5 can use the same address.

b. Independent Fire Detection System: Each existing independent smoke detection subsystem, and kitchen fire extinguishing system shall be monitored both for the presence of an alarm condition and for a trouble condition. Each monitored condition shall be provided with a separate address.

2.2.4 Overvoltage and Surge Protection

a. Signaling Line Circuit Surge Protection: For systems having circuits located outdoors, communications equipment shall be protected against surges induced on any signaling line circuit and shall comply with the applicable requirements of IEEE C62.41.1 and IEEE C62.41.2. Cables and conductors, which serve as communications links, shall have surge protection circuits installed at each end that meet the following waveforms:

(1) A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

(2) An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Protection shall be provided at the equipment. Additional triple electrode gas surge protectors, rated for the application, shall be installed on each wireline circuit within 3 feet of the building cable entrance. Fuses shall not be used for surge protection.

b. Sensor Wiring Surge Protection: Digital and analog inputs and

outputs shall be protected against surges induced by sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested with the following waveforms:

(1) A 10 by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

(2) An 8 by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Fuses shall not be used for surge protection.

2.2.5 Addressable Interface Devices

The addressable interface (AI) device shall provide an addressable input interface to the FACP for monitoring normally open or normally closed contact devices such as waterflow switches, valve supervisory switches, fire pump monitoring, independent smoke detection systems, relays for output function actuation, etc.

2.2.6 Smoke Sensors

2.2.6.1 Photoelectric Smoke Sensors

Provide addressable photoelectric smoke sensors as follows:

a. Provide analog/addressable photoelectric smoke sensors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke sensors shall be listed for use with the fire alarm control panel.

b. Provide self-restoring type sensors which do not require any readjustment after actuation at the FACP to restore them to normal operation. Sensors shall be UL listed as smoke-automatic fire sensors.

c. Components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the detection chamber with a fine mesh metallic screen which prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.

d. Provide twist lock bases for the sensors. The sensors shall maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on the screw terminals. The sensor shall have a visual indicator to show actuation.

e. The sensor address shall identify the particular unit, its location within the system, and its sensitivity setting. Sensors shall be of the low voltage type rated for use on a 24 VDC system.

f. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device.

(1) Primary status
(2) Device type
(3) Present average value
(4) Present sensitivity selected

(5) Sensor range (normal, dirty, etc.)

2.2.6.2 Ionization Type Smoke Sensors

Provide addressable ionization type smoke sensors as follows:

a. Provide analog smoke sensors which operate on the ionization principle and are actuated by the presence of visible or invisible products of combustion. Smoke sensors shall be listed for use with the fire alarm control panel.

b. Provide self-restoring type sensors which do not require any readjustment after actuation at the FACP to restore them to normal operation. Sensors shall be UL listed as smoke-automatic fire sensors.

c. Components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the detection chamber with a fine mesh metallic screen which prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.

d. Provide twist lock bases for the sensors. The sensors shall maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on the screw terminals. The sensor shall have a visual indicator to show actuation.

e. The sensor address shall identify the particular unit, its location within the system, and its sensitivity setting. Sensors shall be of the low voltage type rated for use on a 24 VDC system.

f. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device.

(1) Primary status
(2) Device type
(3) Present average value
(4) Present sensitivity selected
(5) Sensor range (normal, dirty, etc.)

2.2.6.3 Duct Smoke Sensors

Duct smoke sensors shall be analog/addressable photoelectric type as described in paragraph entitled "Photoelectric Smoke Sensors," and shall be provided in ductwork in accordance with NFPA 90A and in accordance with manufacturer’s recommendations.

2.2.6.4 Smoke Sensor Testing

Smoke sensors shall be tested in accordance with manufacturer's recommended calibrated test method. Submit smoke sensor testing procedures for approval.

2.2.7 Thermal Sensors

a. Thermal sensors shall be combination rate-of-rise/fixed temperature sensing. The alarm condition shall be determined by

comparing sensor valve with the stored values.

b. A moving average of the sensor's heat sensing value to automatically compensate for conditions that could affect detection operations. System shall automatically maintain a constant heat sensing sensitivity from each sensor by compensating for environmental factors.

c. Automatic self-test routines shall be performed on each sensor which will functionally check sensor sensitivity electronics and ensure the accuracy of the value being transmitted. Any sensor that fails this test shall indicate a trouble condition with the sensor location at the control panel.

d. An operator at the control panel, having the proper access level, shall have the capability to manually access the following information for each heat sensor:

(1) Primary status

(2) Device type

(3) Present average value

(4) Sensor range (_____)

e. An operator at the control panel, having the proper access level, shall have the capability to manually control the following information for each heat sensor:

(1) Alarm detection sensitivity values

(2) Enable or disable the point/device

(3) Control sensor's relay driver output

2.2.8 Electric Power

2.2.8.1 Primary Power

Provide primary power for the FACP from the normal AC service to the building where shown on the drawings. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of circuits and devices. Make the service connection for the FACP at the main service switchgear, emergency distribution panel where shown, a main distribution panel where shown. Provide appropriate equipment to protect against power surges. Provide a separate NEMA 1 "general purpose enclosure" for the circuit breaker. The circuit breaker enclosure shall be painted red, marked "FIRE ALARM SYSTEM," provided with a red and white engraved plastic sign permanently affixed to the face of the switch, and provided with a lockable handle or cover.

2.2.8.2 Generator

Where any emergency generator provides a standby power supply for life safety system circuits, provide a connection from one of the circuits for the fire alarm system.

2.2.9 Emergency Power Supply

Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.

2.2.9.1 Batteries

Provide sealed, maintenance-free, lead-calcium, sealed lead acid, gel cell, nickel-cadmium, lithium batteries as the source for emergency power to the FACP. Batteries shall contain suspended electrolyte. The battery system shall be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.2.9.2 Capacity

Provide the batteries with sufficient capacity to operate the system under supervisory and trouble conditions, including audible trouble signal devices for 48 hours and audible and visual signal devices under alarm conditions for an additional 10 minutes.

2.2.9.3 Battery Chargers

Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 150 percent of the connected system load and shall maintain the batteries at full charge. In the event the batteries are fully discharged, the charger shall recharge the batteries back to 95 percent of full charge within 48 hours. Provide pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

2.2.10 System Field Wiring

2.2.10.1 Wiring Within Cabinets, Enclosures, Boxes, Junction Boxes, and Fittings

Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make connections with approved pressure type terminal blocks, which are securely mounted. The use of wire nuts or similar devices shall be prohibited.

2.2.10.2 Terminal Cabinets

Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Terminal size shall be appropriate for the size of the wiring to be connected. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the terminal cabinet. Minimum size is 8 inches high by 8 inches.

2.2.10.3 Alarm Wiring

Signaling line circuits and initiating device circuit field wiring shall be

copper, No. 16, 18 AWG size conductors at a minimum. Notification appliance circuit conductors, that contain audible alarm devices, other than speakers, shall be solid copper No. 14 AWG size conductors at a minimum. Speaker circuits shall be copper No. 16 AWG size conductors at a minimum. Firefighter telephone circuits shall be No. 16, 18 AWG size conductors as a minimum. Wire size shall be sufficient to prevent voltage drop problems. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage. Power wiring, operating at 120 VAC minimum, shall be No. 12 AWG solid copper having similar insulation. Provide all wiring in rigid metal conduit or intermediate metal conduit. Electrical metallic tubing conduit is acceptable in dry locations not enclosed in concrete or where not subject to mechanical damage. Conceal conduit in finished areas of new construction and wherever practicable in existing construction. The use of flexible conduit not exceeding a 6 foot length shall be permitted in initiating device circuits. Run conduit or tubing concealed unless specifically shown otherwise on the drawings. Shielded wiring shall be utilized where recommended by the manufacturer. For shielded wiring, the shield shall be grounded at only one point, which shall be in or adjacent to the FACP. T-taps are permitted in Style 4 circuits with interconnections occurring on terminal strips. Color coding is required for circuits and shall be maintained throughout the circuit.

2.2.10.4 Conductor Terminations

Labeling of conductors at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, FACP, and fire alarm control unit shall contain a laminated drawing which indicates each conductor, its label, circuit, and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals. Maintain existing color code scheme where connecting to existing equipment.

2.2.10.5 Wiring to Station Telegraphic Fire Alarm Circuit

Wiring from the master fire alarm box to the station telegraphic fire alarm circuit shall be a two-conductor No. 12, 10 AWG type UF cable in conduit.

2.2.11 Fire Alarm Control Panel (FACP)

Provide a complete control panel fully enclosed in a lockable steel enclosure as specified herein. Operations required for testing or for normal care and maintenance of the systems shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. If more than a single unit is required, and is located in the lobby/entrance, notify the Fire Protection Engineer, via the Contracting Officer, prior to installing the equipment. Each control unit shall provide power, supervision, control, and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each panel with supervisory functions for power failure, internal component placement, and operation. Visual indication of alarm, supervisory, or trouble initiation on the fire alarm control panel shall be by liquid crystal display or

similar means with a minimum of 80 characters of which at least 32 are field changeable.

2.2.11.1 Cabinet

Install control panel components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of panels as well as field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say "Fire Alarm Control Panel" and shall not be less than one inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. The cabinet shall be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.

2.2.11.2 Control Modules

Provide power and control modules to perform all functions of the FACP. Provide audible signals to indicate any alarm, supervisory, or trouble condition. The alarm signals shall be different from the trouble signal. Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the FACP. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage.

2.2.11.3 Silencing Switches

a. Alarm Silencing Switch: Provide an alarm silencing switch at the FACP which shall silence the audible signal but not affect the visual alarm indicator. This switch shall be overridden upon activation of a subsequent alarm.

b. Supervisory/Trouble Silencing Switch: Provide supervisory and trouble silencing switch which shall silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent alarm, supervision, or trouble condition.

2.2.11.4 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually resettable by switch from the FACP after the initiating device or devices have been restored to normal.

2.2.11.5 Fire Alarm Voice Message

A fire alarm shall activate notification appliance circuits. Textual audible appliances shall produce a slow whoop tone for three cycles followed by a voice message which is repeated until the control panel is reset or silenced. Automatic messages shall be broadcast through speakers on appropriate floors, but not in stairs or elevator cabs. The visual strobes and audible message shall automatically be broadcast on the floor of fire alarm origin, the floor, two floors immediately above the floor of fire alarm origin, and the floor immediately below the floor of fire alarm origin. A live voice message shall override the automatic audible output through use of a microphone input at the control panel. When using the

microphone, live messages shall be broadcast through speakers in stairs, in elevator cabs, and throughout a selected floor or floors. The system shall be capable of operating all speakers at the same time. The digitalized voice message shall consist of a non-volatile (EPROM) microprocessor based input to the amplifiers. The microprocessor shall actively interrogate circuitry, field wiring, and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction which could render the digitalized voice module inoperative shall automatically cause the slow whoop tone to take over all functions assigned to the failed unit. Messages shall utilize a male, female voice and shall be as follows:

"May I have your attention, please. May I have your attention, please. A fire has been reported which may affect your floor. Please walk to the nearest exit and evacuate the building." (Provide a 2 second pause.) "May I have your attention, please...(repeat the message)."

"May I have your attention please. May I have your attention please. A fire emergency has been reported in the building. Please leave the building by the nearest exit or exit stairway. Do not use the elevators." (Provide a 2 second pause.) "May I have your attention please..(repeat the message)."

2.2.11.6 Fire Alarm Signal

A fire alarm shall activate notification appliances throughout the building. Audible devices shall be fire alarm horns which produce a three-pulse temporal pattern, continuous slow whoop tone. Visual devices shall be strobes operating in accordance with NFPA 72.

2.2.11.7 Memory

Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.2.11.8 Field Programmability

Provide control units and control panels that are fully field programmable for control, initiation, notification, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. System changes shall be password protected and shall be accomplished using personal computer based equipment.

2.2.11.9 Input/Output Modifications

The FACP shall contain features which allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad and a keyboard. Any bypass or modification to the system shall indicate a trouble condition on the FACP, VDU, and a printed output of the trouble condition.

2.2.11.10 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.

2.2.11.11 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the instructions on the interior of the FACP. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions shall be approved by the Contracting Officer before being posted.

2.2.11.12 Walk Test

The FACP shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.

2.2.11.13 History Logging

In addition to the required printer output, the control panel shall have the ability to store a minimum of 400 events in a log. These events shall be stored in a battery-protected memory and shall remain in the memory until the memory is downloaded or cleared manually. Resetting of the control panel shall not clear the memory.

2.2.11.14 RS-232-C Output

Each local control panel shall be capable of operating remote service type cathode ray tubes (CRTs), printers, and/or modems. The output shall be paralleled ASCII from an EIA RS-232-C connection with a baud rate of 1200 or 2400 to allow use of any commonly available CRT, printer, or modem.

2.2.12 Remote Fire Alarm Control Units

Provide complete remote control units fully enclosed in a lockable steel enclosure as specified herein. Operations required for testing or for normal care and maintenance of the control units shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. Each control unit shall provide power, supervision, control, and logic for its portion of the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each unit with supervisory functions for power failure, internal component placement, and operation.

2.2.12.1 Cabinet

Install remote control unit components in cabinets large enough to accommodate components and also to allow ample gutter space for interconnection of units as well as field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall be labeled "Remote Fire Alarm Control Unit" and shall not be less than one inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. The cabinet shall be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.

2.2.12.2 Control Modules

Provide power and control modules to perform all functions of the remote control unit. Provide audible signals to indicate any alarm or trouble condition. The alarm signals shall be different from the trouble signal. Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the remote control unit. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage. Circuits shall be arranged so that there is 25 percent spare capacity for any circuit.

2.2.12.3 Silencing Switches

Provide an alarm silencing switch at the remote control unit which will silence the audible signal but not affect the visual alarm indicator. This switch shall be overridden upon activation of a subsequent alarm. Provide trouble and supervisory silencing switch which will silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent trouble or supervisory signal.

2.2.12.4 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually resettable by switch from the remote control unit after the initiating device or devices have been restored to normal.

2.2.12.5 Memory

Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.2.12.6 Field Programmability

Provide control units that are fully field programmable for control, initiating, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. System changes shall be password protected and shall be accomplished using personal computer based equipment.

2.2.12.7 Input/Output Modifications

Each remote control unit shall contain features which allow the elimination of input devices from the system or the modification of system outputs. Any such modifications shall indicate a trouble condition on the remote control unit, the FACP, and a printed output of the trouble condition.

2.2.12.8 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory, or trouble condition on the system still exists.

2.2.12.9 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the remote fire alarm control unit. Install the frame in a conspicuous location observable from the remote fire alarm control unit. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions shall be approved by the Contracting Officer before being posted.

2.2.12.10 Walk Test

Each remote control unit shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.

2.2.12.11 History Logging

In addition to the required printer output, the control panel shall have the ability to store a minimum of 400 events in a log. These events shall be stored in a battery-protected memory and shall remain in the memory until the memory is downloaded or cleared manually. Resetting of the control panel shall not clear the memory.

2.2.13 Amplifiers, Preamplifiers, Tone Generators

Any amplifiers, preamplifiers, tone generators, digitalized voice generators, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 shall be housed in a fire alarm control unit, terminal cabinet, or in the fire alarm control panel. The system shall automatically operate and control all building fire alarm speakers except those installed in the stairs and within elevator cabs. The speakers in the stairs and elevator cabs shall operate only when the microphone is used to deliver live messages. Each amplifier shall have two channels; one to broadcast a message and the other for paging.

2.2.13.1 Construction

Amplifiers shall utilize computer grade solid state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient up to 10 times the highest rated voltage in the system.

2.2.13.2 Inputs

Each system shall be equipped with separate inputs from the tone generator, digitalized voice driver and panel mounted microphone. Microphone inputs shall be of the low impedance, balanced line type. Both microphone and tone generator input shall be operational on any amplifier.

2.2.13.3 Tone Generator

The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a

slow whoop tone, which shall slowly ascend from low (500 hertz) to high (1200 hertz), and shall be constantly repeated until interrupted by either the digitalized voice message, the microphone input, or the alarm silence mode as specified. Each slow whoop cycle shall last approximately 4 seconds. The tone generator shall be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay.

2.2.13.4 Protection Circuits

Each amplifier shall be constantly supervised for any condition which could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer to a designated backup amplifier, illumination of a visual "amplifier trouble" indicator on the control panel, appropriate logging of the condition on the system printer, and other actions for trouble conditions as specified.

2.2.14 Video Display Unit (VDU)

a. To eliminate confusion during an alarm situation, the screen shall have dedicated areas for the following functions:

(1) Alarm and returns to normal

(2) Commands, reports, and programming

(3) Time, day, and date

b. Full English language shall be used throughout to describe system activity and instructions. Full English language descriptors defining system points shall be 100 percent field programmable by factory trained personnel, alterable and user definable to accurately describe building areas.

c. Alarms and other changes of status shall be displayed in the screen area reserved for this information. The following information shall be provided in English:

(1) Condition of device (alarm, trouble, or supervisory).

(2) Type of device (manual pull, waterflow, etc.)

(3) Location of device plus numerical system address.

Upon receipt of alarm, an audible alarm shall sound and the condition and point type shall flash until acknowledged by the operator. Returns to normal shall also be annunciated and shall require operator acknowledgment.

d. The system shall have multiple levels of priority for displaying alarms to conform with UL 864. Priority levels shall be as follows:

(1) Level 1 - Fire Alarms

(2) Level 2 - Supervisory Alarms

(3) Level 3 - Trouble Signals

e. The system shall be provided with memory so that no alarm shall be lost. A highlighted message shall advise the operator when unacknowledged alarms are in the system.

f. Multiple levels of access shall be provided for operators and supervisors via user-defined passwords. The following functions shall be provided for each level:

(1) Operator level access functions

(a) Display system directory, definable by device.

(b) Display status of an individual device.

(c) Manual command (alarm device with an associated command shall use the same system address for both functions).

(d) Report generation, definable by device, output on either the VDU or printer, as desired by the operator.

(e) Activate building notification appliances.

(2) Supervisory level access functions

(a) Reset time and date.

(b) Enable or disable event initiated programs, printouts, and initiators.

(c) Enable or disable individual devices and system components.

g. The above supervisory level functions shall not require computer programming skills. Changes to system programs shall be recorded on the printer and maintained in the control panel as a trouble condition.

2.2.15 Graphic Annunciator

2.2.15.1 Annunciator Panel

Provide a graphic annunciator which indicates the building floor plan, including the locations of stairs and elevators. Stairs and elevators shall be identified by letter, number. Alarm circuit boundaries shall be clearly marked on the floor plan. Annunciator shall include a north arrow, location of the fire alarm control panel, and a "you are here" indicator. The graphic annunciator shall be a minimum size of 3 by 3 feet, as indicated on the contract drawings.

2.2.15.2 Indicating Lights

Provide the graphic annunciator with individual light emitting diode (LED) indicating lights for each type of alarm and supervisory device. Provide an amber LED for indicating a system trouble condition and a separate amber LED for indicating a supervisory condition. Provide a green LED to indicate presence of power and a red LED to indicate an alarm condition. The actuation of any alarm signal shall cause the illumination of a boundary LED, a floor LED, and a device LED. System supervisory or trouble

shall cause the illumination of a trouble LED. In addition to all of these LED indicators, provide normal power and emergency power indicating LEDs. Provide a push button LED test switch. The test switch shall not require key operation. Annunciator LEDs shall only be extinguished by operation of the system reset switch on the FACP.

2.2.15.3 Material

Construct the graphic annunciator face plate of smoked Plexiglas, bronze. The LEDs shall be backlit. Control equipment and wiring shall be housed in a recessed, semi-recessed, surface mounted back box. The exposed portions of the back box shall be chrome plated, bronze plated with knockouts.

2.2.15.4 Programming

Where programming for the operation of the proper LEDs is accomplished by a separate software program than the software for the FACP, the software program shall not require reprogramming after loss of power. The software shall be reprogrammable in the field.

2.2.16 System Printers

a. Provide a system printer to record alarm, supervisory, and trouble conditions without loss of any signal or signals. Printout shall be by circuit, device, and function as provided in the FACP. Printer shall operate on a 120 VAC, 60 Hz power supply.

(1) The printer shall have at least 80 characters per line and have a 96 ASCII character set. The printer shall have a microprocessor-controlled, bi-directional, logic seeking head capable of printing 120 characters per second utilizing a 9 by 7 dot matrix print head. Printer shall not contain internal software which is essential for proper operation.

b. When the FACP receives a signal, the alarm, supervisory, and trouble condition shall be printed. The printout shall include the type of signal, the circuit or device reporting, the date, and the time of the occurrence. The printer shall differentiate alarm signals from other printed indications. When the system is reset, this condition shall also be printed including the same information concerning device, location, date, and time. Provide a means to automatically print a list of existing alarm, supervisory, and trouble conditions in the system. If a printer is off-line when an alarm is received, the system shall have a buffer to retain the data and it shall be printed when the printer is restored to service. The printer shall have an indicator to alert the operator that the paper has run out.

2.2.17 Firefighter Telephone Communication System

a. Provide a firefighter telephone system as follows:

(1) Provide a firefighter telephone communication system with complete, common talk, closed circuits. The system shall include, but not be limited to, a master control station mounted in the fire alarm control panel, a power supply and standby battery system, and remote telephone stations.

(2) Provide a master control station which shall provide power,

supervision, and control for wiring, components, and circuits. The act of lifting any remote telephone hand set from its cradle shall cause both a visual and audible signal to annunciate at the master control station. Removing the hand set at the master control station and depressing a button at the remote telephone hand set shall cause the automatic silencing of the audible signal. Communication between the master control station hand set and any/or all remote hand sets shall require the depressing of a push-to-talk switch located on any/all remote hand sets. During the time that the master control hand set is removed from its cradle it shall be possible to communicate between five remote hand sets and the master control station. Hand sets shall be able to monitor any conversation in progress and join the conversation by pressing the push-to-talk button. It shall not be possible to communicate between two or more remote hand sets with the master control station hand set in its cradle. The master control station hand set shall be red in color and equipped with a 5-foot long strain-relieved coiled cord. Wiring connections shall be made to terminal strips. The master control station shall monitor wire and connections for any opens, shorts, or grounds which would render the system inoperable or unintelligible. The master control station shall be equipped with a silencing switch and ring-back feature such that any audible trouble signal can be silenced and shall be so indicated by the lighting of an amber LED. Once any trouble condition has been corrected, the amber LED shall be extinguished and the silencing switch shall sound again until the switch is restored to its original position. The master control station shall be equipped with a separate, LED annunciated switch for each telephone circuit. In addition, LEDs shall provide for the annunciation of operating and supervisory power. The loss of operating or supervisory power shall cause an audible and visual indication at the master control station and shall also cause the fire alarm trouble signal to sound on the FACP. Switches, LEDs, and controls shall be fully labeled.

(3) Provide surface, flush mounted remote telephone stations. Each station shall be equipped with a hinged door that is magnetically locked. Each hand set shall be permanently wired in place with a coiled cord. Each hand set shall be red high-impact cycolac and shall be equipped with a push-to-talk switch which, when operated, shall signal the master control station and a switch-equipped, storage cradle.

(4) Provide operating and supervising power from the same supply circuit(s) utilized for the fire alarm control panel.

2.2.18 Manual Stations

Provide metal or plastic, semi-flush mounted, double action, addressable manual stations, which are not subject to operation by jarring or vibration. Stations shall be equipped with screw terminals for each conductor. Stations which require the replacement of any portion of the device after activation are not permitted. Stations shall be finished in fire-engine red with molded raised lettering operating instructions of contrasting color. The use of a key or wrench shall be required to reset the station.

2.2.19 Notification Appliances

2.2.19.1 Fire Alarm Speakers

a. Provide fire alarm speakers conforming to UL 464 having a minimum of three tap settings and separate terminations for each in and out connection. Tap settings shall include taps of 1/4, 1/2 and 1 watt. Speakers shall utilize the 1/2 watt tap in the system. Speakers shall have an output rating of 84 dBA at 10 feet as determined by the reverberant room test; data on peak output as determined in an anechoic chamber is not suitable. Speakers shall be capable of installation on standard 4 inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single wall mounted unit.

b. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16 gage and equipped with mounting holes and other openings as needed for a complete installation. Fabrication marks and holes shall be ground and finished to provide a smooth and neat appearance for each plate. Each plate shall be primed and painted.

2.2.19.2 Visual Alarm Signals

Provide strobe light visual alarm signals which operate on a supervised 24 volt DC circuit. The strobe lens shall comply with UL 1971 and conform to the Americans With Disabilities Act. The light pattern shall be disbursed so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe. The strobe flash output shall be a minimum of 15 candela based on the UL 1971 test. The strobe shall have a xenon flash tube. Visible appliances may be part of an audio-visual assembly. Where more than two appliances are located in the same room or corridor, provide synchronized operation.

2.2.19.3 Fire Alarm Horns

Provide surface, semi-flush mounted electronic multi-tone horns that produce a minimum of four distinct sounds, suitable for use in an electrically supervised circuit. Horns shall have a rating of 90 dBA at 10 feet when tested in accordance with UL 464 while emitting a slow whoop tone. Output from the horn shall be three-pulse temporal pattern, the slow whoop tone. Where horns and strobes are provided in the same location, they may be combined into a single unit.

2.2.19.4 Fire Alarm Bells

Provide surface, flush mounted bells suitable for use in an electrically supervised circuit. Bells shall be 10 inch vibrating type with a sound output rating of at least 90 dBA at 10 feet when tested in accordance with UL 464.

2.2.19.5 Connections

Provide screw terminals for each notification appliance. Terminals shall be designed to accept the size conductors used in this project without modification.

2.2.20 Valve Monitor Switches (Tamper Switches)

Provide a tamper switch for each fire protection system control valve. Tamper switches shall be UL listed as "Extinguishing System Attachment" for the location and type of valve supervised. The device shall contain double pole, double throw contacts. Operation of the switch shall cause a supervisory signal to be transmitted to the FACP upon not more than two complete turns of the valve wheel or a closure of 10 percent, whichever is less. Tamper switches shall be equipped with screw terminals for each conductor.

2.2.21 Waterflow Detectors

a. Provide vane type waterflow detectors for wet pipe sprinkler systems. The device shall contain double pole, double throw contacts. Equip the detector with a pneumatic time delay, field adjustable from 0 to 90 seconds. The time delay shall be set initially to 30, 45 seconds. The device shall be a UL listed extinguishing system attachment rated for the particular pressure and location at which it is installed. Flow switches shall be equipped with screw terminals for each conductor.

b. Provide pressure type waterflow detectors for dry pipe sprinkler systems. The device shall contain double pole, double throw contacts. The device shall be a UL listed extinguishing system attachment rated for the particular pressure and location at which it is installed. Switch shall be equipped with screw terminals for each conductor.

2.2.22 Electromagnetic Door Holders

Where indicated on the drawings, provide magnetic fire door hold open devices. The electromagnetic holding devices shall be designed to operate on 120 VAC, and require not more than 3 watts of power to develop 25 psi of holding force. The initiation of any fire alarm shall cause the release of the electromagnetic door holding device permitting the door to be closed by the door closer. The device shall be UL listed based on UL 228 tests.

2.2.23 Automatic Transmitters

2.2.23.1 Telegraphic Transmitter

Provide transmitter of the electric motor-driven or pre-wound spring mechanism type which shall transmit not less than four rounds of code. When motor-driven transmitters are provided, the motor shall be connected to a supervised circuit in a control panel. Provide metallic or rigid plastic code number plates on the exterior face of transmitters. Transmitters shall be designed to provide the same features as the fire alarm boxes for electrically supervised, coded positive noninterfering type and shall have the ability to transmit signals on grounded or open circuits. Activation of box when a single open fault is present on exterior fire alarm circuit shall have box to idle for one complete round only, then immediately transmit four complete code rounds via the box earth ground connection. Transmitter shall have a local energy type auxiliary tripping device. Code wheel shall be metallic and box code shall be as directed by the Contracting Officer.

2.2.23.2 Radio Transmitter and Interface Panels

Provide radio transmitter with antenna that is compatible with the existing supervising station fire alarm system. Transmitter shall have a means to transmit alarm, supervisory, and trouble conditions via a single transmitter. Provide transmitters in accordance with applicable portions of NFPA 72, Federal Communications Commission (FCC) 47 CFR 90. Protect the antenna from physical damage. Transmitter shall have a source of power for operation which conforms to NFPA 72. Transmitter shall be capable of initiating a test signal daily at any selected time.

2.2.23.3 Digital Alarm Communicator Transmitter (DACT)

Provide DACT that is compatible with the existing supervising station fire alarm system. Transmitter shall have a means to transmit alarm, supervisory, and trouble conditions via a single transmitter. Transmitter shall have a source of power for operation which conforms to NFPA 72. Transmitter shall be capable of initiating a test signal daily at any selected time. Transmitter shall be arranged to seize telephone circuits in accordance with NFPA 72.

2.2.23.4 Signals To Be Transmitted to the Base Receiving Station

The following signals shall be sent to the base receiving station:

a. Sprinkler water flow

b. Manual pull stations

c. Smoke detectors

d. Duct smoke detectors

e. Sleeping room smoke detectors

f. Heat detectors

g. Sprinkler valve supervision

h. Fire pump running

i. Fire pump loss of power/phase reversal

2.3 NAMEPLATES

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

a. FACPs

b. Automatic transmitter

c. Printer

Furnish to obtain approval by the Contracting Officer before installation. Obtain approval by the Contracting Officer for installation locations.

Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

2.4 WIRING

Provide wiring materials under this section as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

PART 3 EXECUTION

3.1 INSTALLATION OF FIRE ALARM INITIATING AND INDICATING DEVICES

a. FACP: Locate the FACP where indicated on the drawings. Recess, Semi-recess, Surface mount the enclosure with the top of the cabinet 6 feet above the finished floor or center the cabinet at 5 feet, whichever is lower. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the FACP.

b. Manual Stations: Locate manual stations as required by NFPA 101 and NFPA 72, where shown on the drawings. Mount stations so that their operating handles are 4 feet above the finished floor. Mount stations so they are located no farther than 5 feet from the exit door they serve, measured horizontally.

c. Notification Appliance Devices: Locate notification appliance devices as required by NFPA 72, where shown on the drawings. Mount assemblies on walls 80 inches above the finished floor or 6 inches below the ceiling whichever is lower. Ceiling mounted speakers shall conform to NFPA 72.

d. Smoke and Heat Sensors: Locate sensors as required by NFPA 72 and their listings, as shown on the drawings on a 4 inch mounting box. Sensors located on the ceiling shall be installed not less than 4 inches from a side wall to the near edge. Those located on the wall shall have the top of the sensor at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. In raised floor spaces, the smoke sensors shall be installed to protect 225 square feet per sensor. Install smoke sensors no closer than 5 feet from air handling supply outlets.

e. Graphic Annunciator: Locate the graphic annunciator as shown on the drawings. Surface mount the panel, with the top of the panel 6 feet above the finished floor or center the panel at 5 feet, whichever is lower.

f. Water Flow Detectors and Tamper Switches: Locate water flow detectors and tamper switches where shown on the drawings, at each supervised sprinkler valve station.

g. Firefighter Telephones: Locate wall mounted in each stair at each floor landing, in each elevator lobby, and in each elevator cab 4 feet above the finished floor.

h. The modification of any fire alarm system and the procedures shall comply with the requirements of NFPA 241.

3.2 DISCONNECTION AND REMOVAL OF EXISTING SYSTEM

Fire alarm control panels and fire alarm devices disconnected and removed shall be turned over to the Contracting Officer.

a. The existing fire alarm and smoke detection system shall remain in operation at all times during the installation and commissioning of the new system. Once this new system is on-line and accepted by the Government, remove the old system. As new equipment is installed, label it "NOT IN SERVICE." Upon acceptance, remove labels.

b. Disconnect and remove the existing fire alarm and smoke detection systems where indicated and elsewhere in the specification.

c. Properly dispose of fire alarm outlet and junction boxes, wiring, conduit, supports, and other such items.

3.3 CONNECTION OF NEW SYSTEM

The following new system connections shall be made during the last phase of construction, at the beginning of the preliminary tests. New system connections shall include:

a. Connection of new control modules to existing magnetically held smoke door (hold-open) devices.

b. Connection of new elevator recall smoke sensors to existing wiring and conduit.

c. Connection of new system transmitter to existing base fire reporting system.

Once these connections are made, system shall be left energized and new audio/visual devices deactivated. Report immediately to the Contracting Officer, coordination and field problems resulting from the connection of the above components.

3.4 FIRESTOPPING

Provide firestopping for holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with Section 07 84 00 FIRESTOPPING.

3.5 PAINTING

Paint exposed electrical, fire alarm conduit, and surface metal raceway to match adjacent finishes in exposed areas. Paint junction boxes, conduit, and surface metal raceways red in unfinished areas. Painting shall comply with Section 09 90 00 PAINTS AND COATINGS.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

a. Megger Tests: After wiring has been installed, and prior to making any connections to panels or devices, wiring shall be megger tested for insulation resistance, grounds, and/or shorts. Conductors with 300 volt rated insulation shall be tested at a

minimum of 250 VDC. Conductors with 600 volt rated insulation shall be tested at a minimum of 500 VDC. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.

b. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.

c. Preliminary Testing: Conduct preliminary tests to ensure that devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests." After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that panel functions were tested and operated properly. The letter shall include the names and titles of the witnesses to the preliminary tests. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.

d. Request for Formal Inspection and Tests: When tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests to the Contraction Officer.

e. Final Testing: Notify the Contracting Officer in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the operation and maintenance (O&M) manuals are furnished to the Contracting Officer and the following are provided at the job site:

(1) The systems manufacturer's technical representative

(2) Marked-up red line drawings of the system as actually installed

(3) Megger test results

(4) Loop resistance test results

(5) Complete program printout including input/output addresses

The final tests shall be witnessed by the Naval Facilities Engineering Command, Fire Protection Engineer. At this time, any and all required tests shall be repeated at their discretion. Following acceptance of the system, as-built drawings and O&M manuals shall be delivered to the Contracting Officer for review and acceptance. In existing buildings, the transfer of devices from the existing system to the new system and the permission to begin demolition of the old fire alarm system will not be permitted until the as-built drawings and O&M manuals are received.

3.6.2 Minimum System Tests

Test the system in accordance with the procedures outlined in NFPA 72. The required tests are as follows:

a. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.

b. Verify that the control unit is in the normal condition as detailed in the manufacturer's O&M manual.

c. Test each initiating and indicating device and circuit for proper operation and response at the control unit. Smoke sensors shall be tested in accordance with manufacturer's recommended calibrated test method. Testing of duct smoke detectors shall comply with the requirements of NFPA 72.

d. Test the system for specified functions in accordance with the contract drawings and specifications and the manufacturer's O&M manual.

e. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.

f. Determine that the system is operable under trouble conditions as specified.

g. Visually inspect wiring.

h. Test the battery charger and batteries.

i. Verify that software control and data files have been entered or programmed into the FACP. Hard copy records of the software shall be provided to the Contracting Officer.

j. Verify that red-line drawings are accurate.

k. Measure the current in circuits to ensure there is the calculated spare capacity for the circuits.

l. Measure voltage readings for circuits to ensure that voltage drop is not excessive.

m. Disconnect the verification feature for smoke sensors during tests to minimize the amount of smoke needed to activate the sensor. Testing of smoke sensors shall be conducted using real smoke. The use of canned smoke is prohibited.

n. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

3.7 INSTRUCTION OF GOVERNMENT EMPLOYEES

Equipment manufacturer shall provide 3 days on site and 5 days of technical training to the Government at the manufacturing facility. Training shall allow for classroom instruction as well as individual hands on programming, troubleshooting and diagnostics exercises. Room and board costs shall be

included for two Government personnel. Factory training shall occur within 6, 12 months of system acceptance.

3.7.1 Instructor

Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor shall train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm and fire detection system.

3.7.2 Qualifications

Each instructor shall be thoroughly familiar with all parts of this installation. The instructor shall be trained in operating theory as well as in practical O&M work.

3.7.3 Required Instruction Time

Provide 16 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training shall allow for rescheduling for unforeseen maintenance and/or fire department responses.

-- End of Section --

SECTION 31 00 00

EARTHWORK

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
AASHTO T 224	(2001; R 2004) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 139/A 139M	(2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 252	(1998; R 2002) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM D 1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2007) Standard Test Methods for

	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2434	(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(2006) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2007a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements and railroads which comprise stones less than 3 inches in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified

as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.2.5 Topsoil

Material suitable for topsoils obtained from offsite areas, excavations, areas indicated on the drawings is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.2.6 Unstable Material

Unstable material are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.7 Select Granular Material

1.2.7.1 General Requirements

Select granular material consist of materials classified as GW, GP, SW, SP, by ASTM D 2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D 1140. Provide a minimum coefficient of permeability of 0.002 feet per minute when tested in accordance with ASTM D 2434.

1.2.8 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 3/4 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 1/2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.2.9 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 30 when tested in accordance with ASTM D 4318.

1.2.10 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 MEASUREMENT

1.3.1 Excavation

The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. The measurements will include authorized excavation of rock (except for piping trenches that is covered below), authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or the volume of any material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

1.3.2 Piping Trench Excavation

Measure trench excavation by the number of linear feet along the centerline of the trench and excavate to the depths and widths specified for the particular size of pipe. Replace unstable trench bottoms with a selected granular material. Include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping and bailing, and all incidentals necessary to complete the work required by this section.

1.3.3 Rock Excavation for Trenches

Measure and pay for rock excavation by the number of cubic yards of acceptably excavated rock material. Measure the material in place, but base volume on a maximum 30 inch width for pipes 12 inch in diameter or less, and a maximum width of 16 inch greater than the outside diameter of the pipe for pipes over 12 inch in diameter. Provide the measurement to include all authorized overdepth rock excavation as determined by the Contracting Officer. For manholes and other appurtenances, compute volumes of rock excavation on the basis of 1 foot outside of the wall lines of the structures.

1.3.4 Topsoil Requirements

Separate excavation, hauling, and spreading or piling of topsoil and related miscellaneous operations will be considered subsidiary obligations of the Contractor, covered under the contract unit price for excavation.

1.3.5 Select Granular Material

Measure select granular material in place as the actual cubic yards

replacing wet or unstable material in trench bottoms within the limits shown. Provide unit prices which include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring

Dewatering Work Plan

SD-03 Product Data

Utilization of Excavated Materials
Shoulder Construction

Procedure and location for disposal of unused satisfactory material. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing
Borrow Site Testing

Within 24 hours of conclusion of physical tests, 4 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing

Qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

1.6 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3

feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 MATERIAL FOR RIP-RAP

Provide Filter fabric and rock conforming to DOT for construction indicated.

2.4.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, or poorly graded with a maximum particle size of 2 inch. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.

2.5 CAPILLARY WATER BARRIER

Provide capillary water barrier of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Conform to ASTM C 33 for fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or 1-1/2 inch and no more than 2 percent by weight passing the No. 4 size sieve or coarse aggregate Size 57, 67, or 77.

2.6 PIPE CASING

2.6.1 Casing Pipe

ASTM A 139/A 139M, Grade B, or ASTM A 252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated. Protective coating is not required on casing pipe.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inch. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inch in diameter, and other materials that would interfere with planting and maintenance operations. Stockpile in locations indicated any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within

the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on Drawing Sheet No. _____. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least 2 feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete.

3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than 5 feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls more than 5 feet high. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inch inside diameter, and do not exceed 36 inch plus pipe outside diameter for sizes larger than 24 inch inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 2 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, remove such material 12 inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is

responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least 12 inch clear between the outer structure surfaces and the face of the excavation or support members. Clean rock of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, utility is crossing paved raods or parking areas.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D 698 maximum density.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the French Creek borrow pit within the limits of the project site, or from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

The Contractor is responsible for notifying the Contracting Officer sufficiently in advance of the opening of any excavation to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas at Base landfill.

3.5 SHORING

3.5.1 General Requirements

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.6 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. For pile foundations, stop the excavation at an elevation of from 6 to 12 inch above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inch before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density,

break up the ground surface to a minimum depth of 6 inch, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inch and compact it as specified for the adjacent fill.

3.8.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.9 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.10 BURIED TAPE AND DETECTION WIRE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inch below finished grade; under pavements and slabs, bury tape 6 inch below top of subgrade.

3.10.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inch above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over it's entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.11 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare

ground surface on which backfill is to be placed as specified in paragraph GROUND SURFACE PREPARATION. Provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Backfill trenches to the grade shown. Backfill the trench to _____ feet above the top of pipe prior to performing the required pressure tests. Leave the joints and couplings uncovered during the pressure test. Do not backfill the trench until all specified tests are performed.

3.11.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

3.11.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inch loose thickness.

3.11.1.3 Bedding and Initial Backfill

Provide bedding of the type and thickness shown. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D 698 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

a. Class I: Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

3.11.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

a. Roadways, Railroads, and Airfields: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas:

Deposit backfill in layers of a maximum of 12 inch loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Apply this requirement to all other areas not specifically designated above.

3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 18 inch of cover in rock excavation and a minimum 24 inch of cover in other excavation.

3.12.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 1.5 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional 18 inch of cover is required.

3.12.3 Heat Distribution System

Free initial backfill material of stones larger than 1/4 inch in any dimension.

3.12.4 Electrical Distribution System

Provide a minimum cover of 24 inch from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.12.5 Sewage Absorption Trenches or Pits

3.12.5.1 Porous Fill

Provide backfill material consisting of clean crushed rock or gravel having a gradation such that 100 percent passes the 2 inch sieve and zero percent passes the 1/2 inch sieve.

3.12.6 Pipeline Casing

Provide new smooth wall steel pipeline casing under new, existing, railroad and pavement in a trench, by the boring and jacking method of installation. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated. Install pipeline casing by dry boring and jacking method as follows:

3.12.6.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.12.6.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.12.6.3 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight end seals as indicated, segmented elastomeric end seals.

3.12.7 Rip-Rap Construction

Construct rip-rap on filter fabric in accordance with DOT State Standard, in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.12.7.1 Bedding Placement

Spread filter fabric material uniformly to a thickness of at least 3 inch on prepared subgrade as indicated.

3.12.7.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.13 EMBANKMENTS

3.13.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inch in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired

rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade with six passes of a dump truck loaded with 4 cubic yards of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling, provide one-half of the passes made with the truck in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Contracting Officer. Undercut rutting or pumping of material as directed by the Contracting Officer.

3.14.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inch below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, do not show deviations for the surface of the subgrade for roadways greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.14.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 95 percent of laboratory maximum density.

3.14.3.1 Subgrade for Railroads

Compact subgrade for railroads to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials.

3.14.3.2 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 12 inch of subgrade.

3.14.3.3 Subgrade for Shoulders

Compact subgrade for shoulders to at least 85 percentage laboratory maximum

density for the depth below the surface of shoulder shown, full depth of the shoulder.

3.14.3.4 Subgrade for Airfield Pavements

Compact top 24 inch below finished pavement or top 12 inch of subgrades, whichever is greater, to 100 percent of ASTM D 1557; compact fill and backfill material to 100 percent of ASTM D 1557.

3.15 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.16 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.16.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do no disturb the finished subgrade by traffic or other operation. The Contractor is responsible for protecting and maintaining the finsihed subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.16.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16.3 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inch depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of _____ inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas, areas indicated.

3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer. Determine field in-place density in accordance with ASTM D 1556, ASTM D 6938. When ASTM D 6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D 1556. ASTM D 6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D 6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.18.1 In-Place Densities

a. One test per 10,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 1,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

3.18.2 Check Tests on In-Place Densities

If ASTM D 6938 is used, check in-place densities by ASTM D 1556 as follows:

a. One check test per lift for each 10,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 1,000 square feet, of fill or backfill areas compacted by hand-operated machines.

3.18.3 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.18.4 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 5,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.18.5 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.18.6 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 36 inch, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.19 DISPOSITION OF SURPLUS MATERIAL

Provide surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber as wasted in Government disposal area at Camp Lejeune landfill.

-- End of Section --

SECTION 31 11 00

CLEARING AND GRUBBING

04/06

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Nonsaleable Materials

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

SD-04 Samples

Tree wound paint

Herbicide

Submit samples in cans with manufacturer's label.

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to, store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

Bituminous based paint of standard manufacture specially formulated for tree wounds.

2.2 HERBICIDE

Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Protection shall be in accordance with Section 01 57 19.00 20, TEMPORARY ENVIRONMENTAL CONTROLS. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Contracting Officer in ample time to minimize interruption of the service. Refer to Section 01 30 00, ADMINISTRATIVE REQUIREMENTS and Section 01 57 19.00 20, TEMPORARY ENVIRONMENTAL CONTROLS for additional utility protection.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Apply herbicide in accordance with the manufacturer's label to the top surface of stumps designated not to be removed.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 PRUNING

Trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger

than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 DISPOSAL OF MATERIALS

3.6.1 Saleable Timber

1. The Government shall, by separate contract, harvest all saleable timber from the project site. All remaining timber, limbs, tops, stumps, and debris shall be cleared and disposed of by the Contractor as specified.

3.6.2 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of in the designated waste disposal area. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

-- End of Section --

SECTION 31 31 16

SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

7 USC Section 136	Federal Insecticide, Fungicide, and Rodenticide Act

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Termiticide Application Plan

Termiticide application plan with proposed sequence of treatment work with dates and times. The termiticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area/volume treated, amount applied; and the name and state license number of the state certified applicator shall be included.

Termiticides

Manufacturer's label and Material Safety Data Sheet (MSDS) for termiticides proposed for use.

Foundation Exterior

Written verification that other site work will not disturb the treatment.

Utilities and Vents

Written verification that utilities and vents have been located.

Crawl and Plenum Air Spaces

Written verification that crawl spaces and plenum air spaces have been located.

Verification of Measurement

Written verification that the volume of termiticide used meets the application rate.

Application Equipment

A listing of equipment to be used.

Warranty

Copy of Contractor's warrany.

SD-04 Samples

Termiticides

Submit on request samples of the pesticides used in this work or the Contracting Officer may draw, at any time and without prior notice, from stocks at the job site. Should analysis, performed by the Government, indicate such samples to contain less than the amount of active ingredient specified on the label, work performed with such products shall be repeated, with pesticides conforming to this specification, at no additional cost to the Government.

SD-06 Test Reports

Equipment Calibration and Tank Measurement

Certification of calibration tests conducted on the equipment used in the termiticide application.

Soil Moisture

Soil moisture test result.

Quality Assurance

Pest Management Report and copies of daily records signed by an officer of the Contractor.

SD-07 Certificates

Qualifications

Qualifications and state license number of the termiticide applicator.

1.3 QUALIFICATIONS

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed. Termiticide applicators shall also be certified in the U.S. Environmental Protection Agency (EPA) pesticide applicator category which includes structural pest control.

The subcontractor shall:

a. Have personnel with a state of North Carolina certification as required by Pesticide Law of 1971 as amended.

b. Provide a submittal with the following information to the Contracting Officer:

(1) Quantity of pesticide used.

(2) Rate of dispersion.

(3) Percent of use.

(4) Total amount used.

1.4 SAFETY REQUIREMENTS

Formulate, treat, and dispose of termiticides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Contracting Officer, and fit the filling hose with a backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of a contractor's representative to prevent overflow. Secure pesticides and related materials under lock and key when unattended. Ensure that proper protective clothing and equipment are worn and used during all phases of termiticide application. Dispose of used pesticide containers off Government property.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Termiticide material shall be delivered to the site in the original unopened containers bearing legible labels indicating the EPA registration number and manufacturer's registered uses. All other materials to be used on site for the purpose of termite control shall be delivered in new or otherwise good condition as supplied by the manufacturer or formulator.

1.5.2 Storage

Materials shall be stored in designated areas and in accordance with manufacturer's labels. Termiticides and related materials shall be kept under lock and key when unattended.

1.5.3 Handling

Termiticides shall be handled in accordance with manufacturer's labels. Manufacturer's warnings and precautions shall be observed. Materials shall be handled preventing contamination by dirt, water, and organic material. Protect termiticides from sunlight as recommended by the manufacturer.

1.6 INSPECTION

Termiticides shall be inspected upon arrival at the job site for conformity to type and quality in accordance with paragraph TERMITICIDES. Each label shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended or under appropriate regulations of the host county. Other materials shall be inspected for conformance with specified requirements. Unacceptable materials shall be removed from the job site.

1.7 WARRANTY

The Contractor shall provide a 5-year written warranty against infestations or reinfestations by subterranean termites of the buildings or building additions constructed under this contract. Warranty shall include annual inspections of the buildings or building additions. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim, the Contractor shall:

a. Retreat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;

b. Repair damage caused by termite infestation; and

c. Reinspect the building approximately 180 days after the retreatment.

1.8 QUALITY ASSURANCE

The Contractor shall comply with 7 USC Section 136 for requirements on contractor's licensing, certification, and record keeping. The Contractor shall maintain daily records using Pest Management Maintenance Record, DD Form 1532-1 and submit copies of records when requested by the Contracting Officer. These forms may be obtained from the main web site:

http://www.dtic.mil/whs/directives/infomgt/forms/ddforms1500-1999.htm

Upon completion of this work, submit Pest Management Report. DD Form 1532 identifying target pest, type of operation, brand name and manufacturer of pesticide, formulation, concentration or rate of application used.

PART 2 PRODUCTS

2.1 TERMITICIDES

Termiticides shall be currently registered by the EPA or approved for such use by the appropriate agency of the host county. Non-repellant termiticide shall be selected for maximum effectiveness and duration after application. The selected termiticide shall be suitable for the soil and climatic conditions at the project site.

PART 3 EXECUTION

3.1 TECHNICAL REPRESENTATIVE

The certified installation pest management coordinator shall be the technical representative, shall be present at all meetings concerning treatment measures for subterranean termites, and may be present during treatment application. The command Pest Control Coordinator shall be contacted prior to starting work.

3.2 SITE PREPARATION

Site preparation shall be in accordance with Sections 31 11 00 CLEARING AND GRUBBING, 31 00 00 EARTHWORK, 32 92 19 SEEDING, 32 92 23 SODDING, 32 92 26 SPRIGGING, and 32 93 00 EXTERIOR PLANTS. Work related to final grades, landscape plantings, foundations, or any other alterations to finished construction which might alter the condition of treated soils, shall be

coordinated with this specification.

3.2.1 Ground Preparation

Food sources shall be eliminated by removing debris from clearing and grubbing and post construction wood scraps such as ground stakes, form boards, and scrap lumber from the site, before termiticide application begins.

3.2.2 Verification

Before work starts, the Contractor shall verify that final grades are as indicated and smooth grading has been completed in accordance with Section 31 00 00 EARTHWORK. Soil particles shall be finely graded with particles no larger than 1 inch and compacted to eliminate soil movement to the greatest degree.

3.2.3 Foundation Exterior

The Contractor shall provide written verification that final grading and landscape planting operations will not disturb treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures.

3.2.4 Utilities and Vents

The Contractor shall provide written verification that the location and identity of HVAC ducts and vents, water and sewer lines, and plumbing have been accomplished prior to the termiticide application.

3.2.5 Crawl and Plenum Air Spaces

The Contractor shall provide written verification that the location and identity of crawl and plenum air spaces have been accomplished prior to the termiticide application.

3.3 SITE CONDITIONS

The following conditions shall determine the time of application.

3.3.1 Soil Moisture

Soils to be treated shall be tested immediately before application. Soil moisture content shall be tested to a minimum depth of 3 inches. The soil moisture shall be as recommended by the termiticide manufacturer. The termiticide will not be applied when soil moisture exceeds manufacturer's recommendations because termiticides do not adhere to the soil particles in saturated soils.

3.3.2 Runoff and Wind Drift

Termiticide shall not be applied during or immediately following heavy rains. Applications shall not be performed when conditions may cause runoff or create an environmental hazard. Applications shall not be performed when average wind speed exceeds 10 miles per hour. The termiticide shall not be allowed to enter water systems, aquifers, or endanger humans or animals.

3.3.2.1 Vapor Barriers and Waterproof Membranes

Termiticide shall be applied prior to placement of a vapor barrier or waterproof membrane.

3.3.2.2 Utilities and Vents

Prior to application, HVAC ducts and vents located in treatment area shall be turned off and blocked to protect people and animals from termiticide.

3.3.3 Placement of Concrete

Concrete covering treated soils shall be placed as soon as the termiticide has reached maximum penetration into the soil. Time for maximum penetration shall be as recommended by the manufacturer.

3.4 TERMITICIDE TREATMENT

The Contractor shall submit a Termiticide Application Plan for approval before starting the specified treatment.

3.4.1 Equipment Calibration and Tank Measurement

Immediately prior to commencement of termiticide application, calibration tests shall be conducted on the application equipment to be used and the application tank shall be measured to determine the volume and contents. These tests shall confirm that the application equipment is operating within the manufacturer's specifications and will meet the specified requirements. The Contractor shall provide written certification of the equipment calibration test results within 1 week of testing.

3.4.2 Mixing and Application

Formulating, mixing, and application shall be performed in the presence of the Contracting Officer or the technical representative. A closed system is recommended as it prevents the termiticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying termiticides shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.4.3 Treatment Method

For areas to be treated, the Contractor shall establish complete and unbroken vertical and/or horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Application shall not be made to areas which serve as crawl spaces or for use as a plenum air space.

3.4.3.1 Surface Application

Surface application shall be used for establishing horizontal barriers. Surface applicants shall be applied as a coarse spray and provide uniform distribution over the soil surface. Termiticide shall penetrate a minimum of 1 inch into the soil, or as recommended by the manufacturer.

3.4.3.2 Rodding and Trenching

Rodding and trenching shall be used for establishing vertical soil barriers. Trenching shall be to the depth of the foundation footing. Width of trench shall be as recommended by the manufacturer, or as indicated. Rodding or other approved method may be implemented for saturating the base of the trench with termiticide. Immediately after termiticide has reached maximum penetration as recommended by the manufacturer, backfilling of the trench shall commence. Backfilling shall be in 6 inch rises or layers. Each rise shall be treated with termiticide.

3.4.4 Sampling

The Contracting Officer may draw from stocks at the job site, at any time and without prior notice, samples of the termiticides used to determine if the amount of active ingredient specified on the label is being applied.

3.5 VERIFICATION OF MEASUREMENT

Once termiticide application has been completed, tank contents shall be measured to determine the remaining volume. The total volume measurement of used contents for the application shall equal the established application rate for the project site conditions. The Contractor shall provide written verification of the measurements.

3.6 CLEAN UP, DISPOSAL, AND PROTECTION

Once application has been completed, the Contractor shall proceed with clean up and protection of the site without delay.

3.6.1 Clean Up

The site shall be cleaned of all material associated with the treatment measures, according to label instructions, and as indicated. Excess and waste material shall be removed and disposed off site.

3.6.2 Disposal of Termiticide

The Contractor shall dispose of residual termiticides and containers off Government property, and in accordance with label instructions and EPA criteria.

3.6.3 Protection of Treated Area

Immediately after the application, the area shall be protected from other use by erecting barricades and providing signage as required or directed. Signage shall be in accordance with Section 10 14 01 EXTERIOR SIGNAGE. Signage shall be placed inside the entrances to crawl spaces and shall identify the space as treated with termiticide and not safe for children and animals.

3.7 CONDITIONS FOR SATISFACTORY TREATMENT

3.7.1 Equipment Calibrations and Measurements

Where results from the equipment calibration and tank measurements tests are unsatisfactory, re-treatment will be required.

3.7.2 Testing

Should an analysis, performed by a third party, indicate that the samples of the applied termiticide contain less than the amount of active ingredient specified on the label, and/or if soils are treated to a depth less than specified or approved, re-treatment will be required.

3.7.3 Disturbance of Treated Soils

Soil and fill material disturbed after treatment shall be re-treated before placement of slabs or other covering structures.

3.7.4 Termites Found Within the Warranty Period

If live subterranean termite infestation or termite damage is discovered during the warranty period, the Contractor shall re-treat the site.

3.8 RE-TREATMENT

Where re-treatment is required, the Contractor shall comply with the requirements specified in paragraph WARRANTY.

-- End of Section --

SECTION 31 32 11

SOIL SURFACE EROSION CONTROL

10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1560	(2005e1) Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus
ASTM D 1777	(1996; R 2007) Thickness of Textile Materials
ASTM D 2844	(2007) Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D 3776	(2007) Mass Per Unit Area (Weight) of Fabric
ASTM D 3787	(2007) Bursting Strength of Textiles - Constant-Rate-of-Traverse (CRT), Ball Burst Test
ASTM D 3884	(2001; R 2007) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D 4355	(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999a; R 2004e1) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	(2005) Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	(1991; R 2003) Grab Breaking Load and Elongation of Geotextiles

ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(2000e1) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4972	(2001; R 2007) pH of Soils
ASTM D 5034	(1995; R 2001) Breaking Strength and Elongation of Textile Fabrics (Grab Test)
ASTM D 5035	(2006) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D 5268	(2007) Topsoil Used for Landscaping Purposes
ASTM D 5852	(2000; R 2007) Standard Test Method for Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method
ASTM D 648	(2007) Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM D 6629	(2001; R 2007) Selection of Methods for Estimating Soil Loss by Erosion

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work sequence schedule
Erosion control plan; (LEED)

Scale drawings defining areas to receive recommended materials as required by federal, state or local regulations.

Seed Establishment Period

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record

Record of maintenance work performed, of measurements and findings for product failure, recommendations for repair, and products replaced.

SD-03 Product Data

Local/Regional Materials; (LEED)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Manufacturer's literature including physical characteristics, application and installation instructions. Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Equipment

A listing of equipment to be used for the application of erosion control materials.

Finished Grade
Erosion Control Blankets

Condition of finish grade status prior to installation; location of underground utilities and facilities.

SD-04 Samples

Materials

a. Geosynthetic and synthetic binding material; 1 quart.

b. Standard mulch; 2 pounds.

c. Hydraulic mulch; 2 pounds.

d. Geotextile fabrics; 6 inch square.

e. Erosion control blankets; 6 inch square.

f. Synthetic grid systems; One sample grid.

SD-06 Test Reports

Geosynthetic Binders
Hydraulic Mulch
Geotextile Fabrics
Erosion Control Blankets
Synthetic Grid Systems
Articulating Cellular Concrete Block Systems

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

Sand
Gravel

Sieve test results. Sand shall be uniformly graded.

SD-07 Certificates

Fill Material
Mulch
Hydraulic Mulch
Geotextile Fabrics

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

For items listed in this section:

a. Certification of recycled content or,

b. Statement of recycled content.

c. Certification of origin including the name, address and telephone number of manufacturer.

Geosynthetic Binders
Synthetic Soil Binders

Certification for binders showing EPA registered uses, toxicity levels, and application hazards.

Installer's Qualification

The installer's company name and address; training and experience and or certification.

Recycled Plastic

Individual component and assembled unit structural integrity test; creep tolerance; deflection tolerance; and vertical load test results. Life-cycle durability.

Seed

Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

Asphalt Adhesive
Tackifier

Composition.

Wood By-Products

Composition, source, and particle size. Products shall be free from toxic chemicals or hazardous material.

Wood Cellulose Fiber

Certification stating that wood components were obtained from managed forests.

SD-10 Operation and Maintenance Data

Maintenance Instructions

Instruction for year-round care of installed material. The Contractor shall include manufacturer supplied spare parts.

SD-11 Closeout Submittals

Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Recycled Plastic; (LEED)

Wood Cellulose Fiber; (LEED)

Paper Fiber; (LEED)

Mulch Control Netting and Filter Fabric; (LEED)

Hydraulic Mulch (LEED)

Erosion Control Blankets Type XI; (LEED)

Geotextile Fabrics (LEED)

Aggregate; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

1.3 MEASUREMENT AND PAYMENT

1.3.1 Standard and Geosynthetic Binder

The standard and geosynthetic binder shall be measured by the square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching or other miscellaneous materials necessary for placement of the binder.

1.3.2 Mulch and Compost

Mulch and compost shall be measured by the square yard of surface area

covered. No measurement for payment shall be made for binder, dye or other miscellaneous materials or equipment necessary for placement of the mulch or compost.

1.3.3 Hydraulic Mulch

Measure hydraulic mulch by the square yard of surface area covered. Measurement for payment shall include binder, dye or both. No measurement for payment shall be made for other miscellaneous materials or equipment necessary for placement of the hydraulic mulch.

1.3.4 Geotextile Fabric

Measure geotextile fabrics by the square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching or other miscellaneous materials necessary for placement of the fabric.

1.3.5 Erosion Control Blankets

Measure erosion control blankets by the square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching or other miscellaneous materials necessary for placement of the erosion control blankets.

1.3.6 Synthetic Grid/Sheet Systems

Measure synthetic grid/sheet system by the square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching, geotextile, seams, grout, rock, topsoil or other miscellaneous materials necessary for placement of the articulating cellular concrete block system.

1.3.7 Cellular Concrete Block Systems

Measure articulating cellular concrete block system by the square yard of surface area covered. No measurement for payment shall be made for fine grading, trenching, geotextile, seams, grout, rock, topsoil or other miscellaneous materials necessary for placement of the articulating cellular concrete block system.

1.4 DESCRIPTION OF WORK

The work consists of furnishing and installing temporary and permanent soil surface erosion control materials to prevent the pollution of air, water, and land, including fine grading, blanketing, stapling, mulching, vegetative measures, structural measures, and miscellaneous related work, within project limits and in areas outside the project limits where the soil surface is disturbed from work under this contract at the designated locations. This work includes all necessary materials, labor, supervision and equipment for installation of a complete system. Coordinate this section with the requirements of Section 31 00 00 EARTHWORK and Section 32 92 19 SEEDING, and Section 32 92 23 SODDING.

1.5 DELIVERY, INSPECTION, STORAGE, AND HANDLING

Store materials in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage. Do not drop containers from trucks. Material shall be free of defects that would void required performance or warranty. Deliver geosynthetic binders and

synthetic soil binders in the manufacturer's original sealed containers and stored in a secure area.

a. Furnish erosion control blankets and geotextile fabric in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Label erosion control blanket and geotextile fabric rolls to provide identification sufficient for inventory and quality control purposes.

b. All synthetic grids, synthetic sheets, and articulating cellular concrete block grids shall be sound and free of defects that would interfere with the proper placing of the block or impair the strength or permanence of the construction. Minor cracks in synthetic grids and concrete cellular block, incidental to the usual methods of manufacture, or resulting from standard methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

c. Seed shall be inspected upon arrival at the jobsite for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected.

1.6 SUBSTITUTIONS

Substitutions will not be allowed without written request and approval from the Contracting Officer.

1.7 QUALITY ASSURANCE

1.7.1 Installer's Qualification

The installer shall be certified by the manufacturer for training and experience installing the material.

1.7.2 Erosion Potential

Assess potential effects of soil management practices on soil loss in accordance with ASTM D 6629. Assess erodibility of soil with dominant soil structure less than 2.8 to 3.1 inches in accordance with ASTM D 5852.

1.8 SCHEDULING

Submit a construction work sequence schedule, with the erosion control plan a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures to reduce on-site erosion and off-site sedimentation. Coordinate installation of temporary erosion control features with the construction of permanent erosion control features to assure effective and continuous control of erosion, pollution, and sediment deposition. Include a vegetative plan with planting and seeding dates and fertilizer, lime, and mulching rates. Distribute copies of the work schedule and erosion control plan to site subcontractors. Address the following in the erosion control plan:

a. Statement of erosion control and stormwater control objectives.

b. Description of temporary and permanent erosion control, stormwater control, and air pollution control measures to be implemented on site.

c. Description of the type and frequency of maintenance activities required for the chosen erosion control methods.

d. Comparison of proposed post-development stormwater runoff conditions with predevelopment conditions.

1.9 TIME LIMITATIONS

Complete backfilling the openings in synthetic grid systems and articulating cellular concrete block systems a maximum 7 days after placement to protect the material from ultraviolet radiation.

1.10 WARRANTY

Erosion control material shall have a warranty for use and durable condition for project specific installations. Temporary erosion control materials shall carry a minimum eighteen month warranty. Permanent erosion control materials shall carry a minimum three year warranty.

PART 2 PRODUCTS

2.1 RECYCLED PLASTIC

Recycled plastic shall contain a minimum 85 percent of recycled post-consumer product. Recycled material shall be constructed or manufactured with a maximum 1/4 inch deflection or creep in any member, according to ASTM D 648 and ASTM D 1248. The components shall be molded of ultraviolet (UV) and color stabilized polyethylene. The material shall consist of a minimum 75 percent plastic profile of high-density polyethylene, low-density polyethylene, and polypropylene raw material. The material shall be non-toxic and have no discernible contaminates such as paper, foil, or wood. The material shall contain a maximum 3 percent air voids and shall be free of splinters, chips, peels, buckling, and cracks. Material shall be resistant to deformation from solar heat gain.

2.2 BINDERS

2.2.1 Synthetic Soil Binders

Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

2.2.2 Geosynthetic Binders

Geosynthetic binders shall be manufactured in accordance with ASTM D 1560, ASTM D 2844; and shall be referred to as products manufactured for use as modified emulsions for the purpose of erosion control and soil stabilization. Emulsions shall be manufactured from all natural materials and provide a hard durable finish.

2.3 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.3.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in

air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.3.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.3.3 Mulch Control Netting and Filter Fabric

Mulch control netting and filter fabric may be constructed of lightweight recycled plastic, cotton, or paper or organic fiber. The recycled plastic shall be a woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from UV, and with the following properties:

a. Minimum grab tensile strength (TF 25 #1/ASTM D 4632), 180 pounds.

b. Minimum Puncture (TF 25 #4/ASTM D 3787), 75 psi in the weakest direction.

c. Apparent opening sieve size of a minimum 40 and maximum 80 (U.S. Sieve Size).

d. Minimum Trapezoidal tear strength (TF 25 #2/ASTM D 4533), 50 pounds.

2.4 GEOTEXTILE FABRICS

Geotextile fabrics shall be woven of polyester or polypropylene filaments formed into a stable network so that the filaments retain their relative position to each other. Content shall be a minimum of 75 percent recycled materials. Sewn seams shall have strength equal to or greater than the geotextile itself. Install fabric to withstand maximum velocity flows as recommended by the manufacturer. The geotextile shall conform to the following minimum average roll values:

Property	Performance	Test Method
Weight		ASTM D 3776
Thickness		ASTM D 1777
Permeability		ASTM D 4491
Abrasion Resistance, Type (percent strength retained)	58 percent X 81 percent	ASTM D 3884
Tensile Grab Strength	1,467 N X 1, 933 N	ASTM D 4632
Grab Elongation	15percent X 20percent	ASTM D 4632
Burst Strength	5,510 kN/m^2	ASTM D 3787
Puncture Strength	733 N	ASTM D 4833
Trapezoid Tear	533 N X 533 N	ASTM D 4533
Apparent Opening Size	40 US Std Sieve	ASTM D 4751
UV Resistance @ 500 hrs	90 percent	ASTM D 4355

2.5 EROSION CONTROL BLANKETS

2.5.1 Erosion Control Blankets Type I

Use Type I blankets for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blankets shall be a machine-produced mat of 100% straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. cover the blanket on the top side with a photodegradable polypropylene netting having an approximate 1/2 by 1/2 inch mesh and be sewn together on a maximum 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.50 lb/yd^2 weight
Netting	One side only, lightweight photodegradable with approximately 1.64 lb/1,000 ft^2 weight.
Thread	Degradable

Note 1: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1 gradient.

2.5.2 Erosion Control Blankets Type II

Erosion control blankets shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top side with a polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographic location and elevation. Sew the blanket together on a maximum 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.50 lb/yd^2 weight.
Netting	One side only, photodegradable with photo accelerators and approximately 1.64 lb/1,000 ft^2 weight.
Thread	Degradable

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 3:1 gradient.

2.5.3 Erosion Control Blankets Type III

Type III blankets shall be used for erosion control and vegetation establishment on roadside embankments, abutments, berms, shoulders, and median swales where natural vegetation will provide long term stabilization. Erosion control blanket shall be a machine-produced mat consisting of 70 percent straw and 30 percent coconut fiber. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat. Cover the blanket on the top side with heavyweight photodegradable polypropylene netting having UV additives to delay breakdown and an approximate 5/8 by 5/8 inch mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 1/2 by 1/2 inch mesh. Sew the blanket together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	70 percent by approximately 0.35 lb/yd^2.
Coconut Fiber	30 percent by approximately 0.15 lb/yd^2 weight.
Netting	Top side heavyweight photodegradable with UV additives and approximately 3 lb/1,000 ft^2 weight Bottom side lightweight photodegradable with approximately 1.64 lb/1,000 ft^2 weight.

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes with a gradient less than 1.5:1.

2.5.4 Erosion Control Blankets Type IV

Erosion control blanket shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top and bottom sides with lightweight photodegradable polypropylene netting having an approximate 1/2 by 1/2 inch mesh. Sew the blanket together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.5 lb/yd^2 weight.
Netting	Both sides lightweight photodegradable with approximately 1.64 lb/1,000 ft^2 weight.
Thread	Degradable

Material Content

NOTE: Photodegradable life a minimum of 2 months with a minimum 90 percent light penetration. Apply to slopes with a gradient of less than 1.5:1.

2.5.5 Erosion Control Blankets Type V

Erosion control blanket shall be a machine-produced mat of 100 percent straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top side with polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photodegradable accelerators to provide breakdown of the netting within approximately 45 days, depending upon geographic location and elevation. Cover the bottom with a polypropylene netting having an approximate 1/2 by 1/2 inch mesh with photo accelerators. Sew the blanket together on 1.5 inch centers with degradable thread. The erosion control blanket shall have the following properties:

Material Content

Straw	100 percent with approximately 0.5 lb/yd^2 weight.
Netting	Top side lightweight photodegradable with photo accelerators with approximately 1.64 lb/1,000 ft^2 weight.
Thread	Bottom side lightweight photodegradable with photo accelerators and approximately 1.64 lb/1,000 ft^2 weight.

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 2:1 gradient.

2.5.6 Erosion Control Blankets Type VI

Erosion control blanket shall be a machine-produced 100% biodegradable mat with a 100 percent straw fiber matrix. The blanket shall be of consistent thickness with the straw fiber evenly distributed over the entire area of the mat. Cover the blanket on the top side with a 100 percent biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. Sew the blanket together with biodegradable thread on 1.5 inch centers. The erosion control blanket shall have the following properties:

Material Content

Matrix	100 percent straw fiber with approximately 0.50 lb/yd^2 weight
Netting	One side only, Leno woven 100% biodegradable natural organic fiber

Material Content

Weight	approximately 9.3 lb/1,000 ft.
Thread	Biodegradable

NOTE: Photodegradable life a minimum of 10 months with a minimum 90 Percent light penetration. Apply to slopes up to a maximum 2:1 gradient.

2.5.7 Erosion Control Blankets Type VII

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with an herbaceous straw fiber matrix. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. Cover the blanket on the top and bottom sides with 100 percent biodegradable woven natural fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. Sew the blanket together with biodegradable thread on 1.5 inch centers. The blanket shall have the following properties:

Material Content

Straw	100 percent straw fiber with approximately 0.5 lb/yd^2 weight.
Netting	Top and bottom sides,Leno woven 100% biodegradable natural organic fiber with approximately 9.3 lb/1,000ft^2 weight.
Thread	Biodegradable

Note: Photodegradable life a minimum of 18 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1.5:1 gradient.

2.5.8 Erosion Control Blankets Type VIII

Erosion control blanket shall be a machine-produced 100 percent biodegradable mat with a 70 percent herbaceous straw and 30 percent coconut fiber blend matrix. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat. Cover the blanket on the top and bottom sides with 100 percent biodegradable woven natural organic fiber netting. The netting shall consist of machine directional strands formed from two intertwined yarns with cross directional strands interwoven through the twisted machine strands (commonly referred to as a Leno weave) to form an approximate 1/2 by 1/2 inch mesh. Sew the blanket together with biodegradable thread on 1.5 inch centers. Straw/Coconut fiber erosion control blanket shall have the following properties:

Material Content

Matrix	70 percent straw fiber with approximately . 0.35 lb/yd^2 weight. 30 percent coconut fiber cured in fresh water with approximately

0.15 lb/yd^2 weight.

Netting	Both sides woven 100% biodegradable natural organic fiber with approximately 9.3 lbs/1,000 ft^2 weight.
Thread	Biodegradable

NOTE: Photodegradable life a minimum of 24 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1.5:1 gradient.

2.5.9 Erosion Control Blankets Type IX (Turf Reinforcement Mat)

Permanent erosion control/turf reinforcement mat is constructed of 100 percent coconut fiber stitch bonded between a heavy duty UV stabilized bottom net, and a heavy duty UV stabilized cuspated (crimped) middle netting overlaid with a heavy duty UV stabilized top net. The cuspated netting forms prominent closely spaced ridges across the entire width of the mat. The three nettings are stitched together on 1.5 inch centers with UV stabilized polypropylene thread to form a permanent three dimensional structure. The following list contains further physical properties of the turf erosion control mat.

Property	Test Method	Value	Units
Ground Cover	Image Analysis	93	percent
Thickness	ASTM D 1777		0.63 in
Mass Per Unit Area	ASTM D 3776		0.92 lb/sy
Tensile Strength	ASTM D 5035		480 lb/ft
Elongation	ASTM D 5035		percent
Tensile Strength	ASTM D 5035		960 lb/ft
Elongation	ASTM D 5035	31	percent
Tensile Strength	ASTM D 5034, ASTM D 5035		177 lbs
Elongation	ASTM D 5034, ASTM D 5035	22	percent
Resiliency	ASTM D 1777	greater than 80	percent
UV Stability*	ASTM D 4355		151 lbs
		86	percent
Color(permanent net)		UV Black	
Porosity(permanent net)Calculated		greater than 95	percent
Minimum Filament Measured Diameter (permanent net)			0.03 in

NOTE 1: *ASTM D 5034, ASTM D 5035 Tensile Strength and percent Strength Retention of material after 1000 hours of exposure in Xenon-Arc Weatherometer

NOTE 2: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1:1 gradient.

2.5.10 Erosion Control Blankets Type X (Turf Reinforcement Mat)

Permanent erosion control/turf reinforcement mat shall be constructed of 100 percent UV stabilized high denier polypropylene fiber sewn between a black UV stabilized 1/2 inch mesh polypropylene netting on the top 5 lbs/1000 square ft and a black UV stabilized 5/8 inch mesh polypropylene netting on the bottom 3 lbs/1000 square ft with polypropylene thread. The mat shall be resistant to photo and chemical degradation. The following list contains further physical properties of the turf reinforcement mat.

Property	Test Method	Value	Units
Thickness	ASTM D 1777		0.56 in
Resiliency	100 PSI-3 cycles	94	percent
Mass Per Unit Area	ASTM D 3776		11.2 oz/sq yd
Tensile Strength	ASTM D 4632		35.2 lbs
Elongation	ASTM D 4632	25.5	percent
Tensile Strength	ASTM D 4595		259.2 lbs/ft
Elongation	ASTM D 4595	20.9	percent
Tensile Strength	ASTM D 5035		300 lbs/ft
Elongation	ASTM D 5035	51	percent
Tensile Strength	ASTM D 5034, ASTM D 5035		89 lbs
Elongation	ASTM D 5034, ASTM D 5035	21	percent
UV Stability*	ASTM D 4355		81* lbs
		90*	percent

NOTE 1: *ASTM D 5034, ASTM D 5035 Tensile Strength and percent Strength Retention of material after 1000 hours of exposure in Xenon-Arc Weatherometer.

NOTE 2: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a maximum 1:1 gradient.

2.5.11 Erosion Control Blankets Type XI (Re-vegetation Mat)

Seed-incorporated blanket option shall consist of 2-ply 100 percent recycled, unbleached, cellulose tissue. Uniformly distribute a seed mix upon the bottom ply of cellulose tissue and fully overlaid with a top cellulose ply to provide complete envelopment of the seed layer. Sew the seed-incorporated cellulose medium to the bottom side of the specified erosion control blanket.

Material Content

Top ply 1-ply 100 percent recycled unbleached cellulose tissue with approximately 4.3 lbs/1,000 ft^2 weight.

Seed 0.033 lbs/yd^2 (160 lbs/acre)

0.017 lbs/yd^2 (80 lbs/acre)

Bottom ply 1-ply recycled unbleached cellulose issue with approximately 4.3 lbs/(1,000 ft^2) weight.

Material Content
NOTE: Photodegradable life a minimum of 36 months with a minimum 90 percent light penetration. Apply to slopes up to a minimum 1:1 gradient.

2.5.12 Erosion Control Blankets Type XII (Compost Mat)

Compost blanket shall consist of a layer of 100 percent biobased stable and mature compost uniformly distributed to a depth of 3/4 to 3 inches along slopes with erosion potential. Compost shall encourage plant growth and seed shall be applied following compost application. The blanket shall have the following properties:

Parameter	Range
Particle size	3/8-1/2 inch sieve and 2-3 inch sieve (ratio = 3:1)
Moisture content	20% - 50%
Soluble salt	3.0 - 6.0 mmhos/cm
Organic matter	40% - 70%
pH	6.0 - 8.0
Nitrogen content	0.5% - 2.0%
Human made inerts	0.0% - 1.0%

2.5.13 Seed

2.5.13.1 Seed Classification

State-certified, State-approved native seed mix of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Conform labels to the AMS Seed Act and applicable state seed laws. Submit the Seed Establishment Period information as specified in the Submittals paragraph.

2.5.13.2 Permanent Seed Species and Mixtures

Proportion permanent seed species and mixtures by weight as follows:

Mixture Percent by Weight	Percent Pure Live Seed	Botanical Name	Common Name
_____	_____	_____	_____

2.5.13.3 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.5.14 Staking

Stakes shall be 100 percent biodegradable manufactured from recycled plastic or wood and shall be designed to safely and effectively secure erosion control blankets for temporary or permanent applications. The biodegradable stake shall be fully degradable by biological activity within a reasonable time frame. The bio-plastic resin used in production of the biodegradable stake shall consist of polylactide, a natural, completely biodegradable substance derived from renewable agricultural resources. The biodegradable stake must exhibit ample rigidity to enable being driven into

hard ground, with sufficient flexibility to resist shattering. Serrate the biodegradable stake on the leg to increase resistance to pull-out from the soil.

2.5.15 Staples

Staples shall be as recommended by the manufacturer.

2.6 SEDIMENT FENCING

Woven polypropylene filter fabric (ASTM D 4632) installed with steel post and fencing.

2.7 WATER

Unless otherwise directed, water is the responsibility of the Contractor. Water shall be potable or supplied by an existing irrigation system.

PART 3 EXECUTION

3.1 CONDITIONS

Perform erosion control operations under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed. When special conditions warrant a variance to earthwork operations, submit a revised construction schedule for approval. Do not apply erosion control materials in adverse weather conditions which could affect their performance.

3.1.1 Finished Grade

Verify that finished grades are as indicated on the drawings; complete finish grading and compaction in accordance with Section 31 00 00 EARTHWORK, prior to the commencement of the work. Verify and mark the location of underground utilities and facilities in the area of the work. Repair damage to underground utilities and facilities at the Contractor's expense.

3.1.2 Placement of Erosion Control Blankets

Before placing the erosion control blankets, ensure the subgrade has been graded smooth; has no depressed, void areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter. Verify that mesh does not include invasive species. Vehicles shall not be permitted directly on the blankets.

3.2 SITE PREPARATION

3.2.1 Soil Test

Test soil in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size and mechanical analysis. Sample collection onsite shall be random over the entire site. The test shall determine the soil particle size as compatible for the specified material.

3.2.2 Layout

Erosion control material locations may be adjusted to meet field conditions. When soil tests result in unacceptable particle sizes, a shop

drawing shall be submitted indicating the corrective measures.

3.2.3 Protecting Existing Vegetation

When there are established lawns in the work area, the turf shall be covered and/or protected or replaced after construction operations. Identify existing trees, shrubs, plant beds, and landscape features that are to be preserved on site by appropriate tags and barricade with reusable, high-visibility fencing along the dripline. Mitigate damage to existing trees at no additional cost to the Government. Damage shall be assessed by a state certified arborist or other approved professional using the National Arborist Association's tree valuation guideline.

3.2.4 Obstructions Below Ground

When obstructions below ground affect the work, submit shop drawings showing proposed adjustments to placement of erosion control material for approval.

3.3 INSTALLATION

Immediately stabilize exposed soil using fabric, mulch, and seed. Stabilize areas for construction access immediately as specified in the paragraph Construction Entrance. Install principal sediment basins and traps before any major site grading takes place. Provide additional sediment traps and sediment fences as grading progresses. Provide inlet and outlet protection at the ends of new drainage systems. Remove temporary erosion control measures at the end of construction after permanent seeding is established.

3.3.1 Construction Entrance

Provide as indicated on drawings, a minimum of 6 inches thick, at points of vehicular ingress and egress on the construction site. Construction entrances shall be cleared and grubbed, and then excavated a minimum of 3 inches prior to placement of the filter fabric and aggregate. The aggregate shall be placed in a manner that will prevent damage and movement of the fabric. Place fabric in one piece, where possible. Overlap fabric joints a minimum of 12 inches.

3.3.2 Seeding

When seeding is required prior to installing mulch on synthetic grid systems verify that seeding will be completed in accordance with Sections 31 00 00 EARTHWORK and 32 92 19 SEEDING.

3.3.3 Mulch Installation

install mulch on all seeded areas. Apply mulch evenly at the rate of 4000 lbs per acre. All mulch must be mechanically anchored.

3.3.4 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.3.5 Erosion Control Blankets

a. Install erosion control blankets as indicated and in accordance with manufacturer's recommendations. The extent of erosion control blankets shall be as shown on drawings.

b. Orient erosion control blankets in vertical strips and anchored with staples, as indicated. Abut adjacent strips to allow for installation of a common row of staples. Overlap horizontal joints between erosion control blankets sufficiently to accommodate a common row of staples with the uphill end on top.

c. Where exposed to overland sheet flow, locate a trench at the uphill termination. Staple the erosion control blanket to the bottom of the trench. Backfill and compact the trench as required.

d. Where terminating in a channel containing an installed blanket, the erosion control blanket shall overlap installed blanket sufficiently to accommodate a common row of staples.

3.3.6 Seeding, Fertilizing, Mulching

Install seed in accordance with Section 32 92 19 SEEDING.

3.3.7 Sediment Fencing

Install posts at the spacing 6 feet maximum and at an angle between 2 degrees and 20 degrees towards the potential silt load area. Sediment fence height shall be approximately 36 inches. Do not attach filter fabric to existing trees. Secure filter fabric to the post and wire fabric using staples, tie wire, or hog rings. Imbed the filter fabric into the ground in a 4- by 12-inch trench and compact after backfill. Splice filter fabric at support pole using a 6 inches overlap and securely seal.

3.4 CLEAN-UP

Dispose of excess material, debris, and waste materials offsite at an approved landfill or recycling center. Clear adjacent paved areas. Immediately upon completion of the installation in an area, protect the area against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.5 WATERING SEED

Start watering immediately after installing erosion control blanket type XI (revegetation mat). Apply water to supplement rainfall at a sufficient rate to ensure moist soil conditions to a minimum 1 inch depth. Prevent run-off and puddling. Do no drive watering trucks over turf areas, unless otherwise directed. Prevent watering of other adjacent areas or plant material.

3.6 MAINTENANCE RECORD

Furnish a record describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

3.6.1 Maintenance

Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.

3.6.2 Maintenance Instructions

Furnish written instructions containing drawings and other necessary information, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement.

3.6.3 Patching and Replacement

Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer. Remove material not meeting the required performance as a result of placement, seaming or patching from the site. Replace the unacceptable material at no additional cost to the Government.

3.7 SATISFACTORY STAND OF GRASS PLANTS

When erosion control blanket type XI (revegetation mat) is installed, evaluate the grass plants for species and health when the grass plants are a minimum 1 inch high. A satisfactory stand of grass plants from the revegetation mat area shall be a minimum 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total revegetation mat area.

-- End of Section --

SECTION 32 10 00

BITUMINOUS CONCRETE PAVEMENT

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 230	(1968; R 2000) Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures
AASHTO T 30	(2007) Mechanical Analysis of Extracted Aggregate

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2172	(2005) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2950	(2005) Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D 6155	(2006) Nontraditional Coarse Aggregate for Bituminous Paving Mixtures

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED	(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 RELATED SECTIONS

Pervious pavement systems shall use Section 32 11 16.16 SUBBASE COURSE FOR PERVIOUS PAVING, Section 32 11 24 GRADED CRUSHED AGGREGATE BASE COURSE FOR PERVIOUS PAVEMENT, and Section 32 12 10 BITUMINOUS TACK AND PRIME COATS in addition to this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Precast car stops; (LEED)
Asphalt cement; (LEED)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Local/Regional Materials; (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

SD-04 Samples

Pavement cores

SD-06 Test Reports

Trial batch reports

Mix design

Asphalt concrete

Density

Thickness

Straightedge test

Submit reports for testing specified under paragraph entitled "Field Quality Control."

SD-07 Certificates

Asphalt mix delivery record

Asphalt concrete and material sources

Obtain approval of the Contracting Officer for materials and material sources 2 days prior to the use of such material in the work.

Asphalt concrete

Curbs

Guard (Guide) rails

Median barriers

Traffic signs

Submit certificates, signed by the producer, that paving materials and incidental construction items conform to specification requirements.

1.4 QUALITY ASSURANCE

1.4.1 Regulatory Requirements

Provide work and materials in accordance with applicable requirements of NCDOT. Paragraphs in NCDOT entitled "Method of Measurement" and "Basis of Payment" shall not apply.

1.4.2 Modification of References

Where term "Engineer" is used in NCDOT it shall be construed to mean Contracting Officer. Where term "state" is used, it shall mean "Federal Government".

1.4.3 Mix Delivery Record Data

Record and submit the following information to each load of mix delivered to the job site. Submit within one day after delivery on Government-furnished forms:

a. Truck No:

b. Time In:

c. Time Out:

d. Tonnage and Discharge Temperature:

e. Mix Type:

f. Location:

g. Stations Placed:

1.4.4 Trial Batch

Submit current bituminous design reports for all mix types proposed for use on the project.

1.4.5 Mix Design

Submit results of laboratory tests performed on each mix design. Testing shall have been accomplished not more than one year prior to date of material placement.

1.4.6 Field-Constructed Mockup

Install minimum 225 square feet to demonstrate typical joints, surface finish, texture, color, permeability, and standard of workmanship. When Contracting Officer determines that mockup does not meet requirements, demolish and remove it from the site and install another until the mockup is accepted. Keep accepted mockup undisturbed during construction as a standard for judging completed paving. Accepted mockup may be incorporated into final work when approved by Contracting Officer.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not produce or place bituminous concrete when the weather is rainy or foggy, when the base course is frozen or has excess moisture, or when the ambient temperature is less than 40 degrees F in the shade away from artificial heat.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Paving materials may be locally available.

PART 2 PRODUCTS

2.1 ASPHALT CONCRETE

Provide asphalt concrete in accordance with the applicable requirements of the NCDOT, except where specified otherwise. Recycled asphalt pavement material may be used as permitted by NCDOT.

2.2 BASE COURSE

NCDOT, materials for construction of the base course shall be in accordance with Section 610, B-25.OC.

2.3 SURFACE COURSE

NCDOT, materials for construction of the surface course shall be in accordance with Section 610, SF-95A or 5-9.5C as indicated on drawing.

2.4 TRAFFIC SIGNS

NCDOT, provide traffic signs in accordance with Section 900, 901, 902, 903, and 904.

2.5 PRECAST CAR STOPS

Provide car stops to the profile and size indicated. Manufacture with air entrained concrete having a minimum compressive strength of 3,000 psi at 28 days, with two No. 4 reinforcing rods located at mid-point of its cross section and with two galvanized sleeves for anchoring.

2.6 COMPOSITION OF MIXTURE REQUIREMENTS

2.6.1 Mixture Properties

Gradation of mineral aggregate shall be as specified. Percentage of bituminous material provided in the bituminous mixtures shall be within the limits specified. Mixtures shall have the following physical properties:

Test Property	Values
Stability (50 Blows)	Not less than 1000 pounds

Test Property	Values
Flow (0.01 inch)	Not more than 20 nor less than 8
Percent Air Voids	Not less than 3 nor more than 8 for binder course; not less than 3 nor more than 5 for wearing course
Percent Voids in Mineral Aggregates	See Table I

TABLE I

MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE (VMA)

U.S.A. Standard Sieve Designation	Nominal Maximum Particle Size, Inch	Minimum VMA Percent
No. 4	0.187	18
3/8 inch	0.375	16
1/2 inch	0.500	15
3/4 inch	0.750	14
1 inch	1.000	13

2.6.2 Aggregate

2.6.2.1 Course Aggregate

Coarse aggregate shall contain a minimum of 25 percent recycled porcelain, concrete, stone, or other recycled material complying with ASTM D 6155.

2.6.3 Quantity of Bituminous Material

Asphalt cement shall contain a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent pre-consumer recycled content. Mix asphalt cement with aggregates of corresponding mixes in the following proportions:

ASPHALT CEMENT PERCENT BY WEIGHT OF TOTAL MIX

Binder Course	Wearing Course
4 to 8	5 to 9

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Excavation and Filling

Excavation and filling to establish elevation of subgrade is specified in Section 31 00 00 EXCAVATION.

3.2 CONSTRUCTION

Provide construction in accordance with the applicable requirements of the NCDOT, except where indicated or specified otherwise.

3.2.1 Edge Restraints

Install edge restraints of pervious systems per the drawings and

manufacturer's recommendations.

3.2.2 Surface Course

NCDOT, methods of construction of the surface course shall be in accordance with Section 610. Placement will not be permitted unless the Contractor has a working asphalt thermometer on site. Install surface elevation of the pervious paving system 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars, or channels.

3.2.3 Striping

NCDOT, provide paint striping in accordance with Section _____, Section _____, paragraph _____. Allow bituminous pavement to cure for at least 21 days before paint is applied. Pavement shall be thoroughly clean and entirely free of loose sand, stones, dust, oil, grease, water, and other substances that will be deleterious to the paint or will adversely affect the adhesion of the paint. Do not apply paint during high wind (over 15 miles per hour) or high humidity (over 70 percent). Apply paint only when ambient temperature is 40 degrees F or above and rising but not more than 95 degrees F. Dimensions and arrangement of striping shall be as indicated. Apply paint to a wet film thickness of 0.015 inch by means of conventional traffic line striping equipment. Traffic shall not be permitted to use the painted areas for a minimum of 30 minutes after painting of lines has been completed.

3.2.4 Traffic Signs

NCDOT, install traffic signs in accordance with Section 900, 901, 092, 903, and 904.

3.2.5 Precast Car Stops

Provide car stops where indicated. Install with an anchor rod driven through each sleeve.

3.3 FIELD QUALITY CONTROL

Sample shall be taken by Contractor as specified herein. Contractor shall replace pavement where sample cores have been removed. Submit 2 pavement cores when using the in-place nuclear density method.

3.3.1 Sample and Core Identification

Place each sample and core in a container and securely seal to prevent loss of material. Tag each sample for identification. Tag shall contain the following information:

a. Contract No.

b. Sample No.

c. Quantity

d. Date of Sample

e. Sample Description

f. Source/Location/Stations Placed/depth below the finish grade

g. Intended Use

h. Thicknesses of various lifts placed

3.3.2 Testing

3.3.2.1 Bituminous Mix Testing

Take two samples per day per mix type at plant or from truck. Test uncompacted mix for extraction in accordance with ASTM D 2172 and sieve analysis in accordance with AASHTO T 30. Test samples for stability and flow in accordance with ASTM D 1559. When two consecutive tests fail to meet requirements of specifications, cease placement operations and test a new trial batch prior to resumption of placement operations. Submit 2 per day of each mix type. When two tests on uncompacted mix fail submit new trial batch for approval.

3.3.2.2 Testing of Pavement Course

a. Density: Determine density of pavement by testing cores obtained from the binder and wearing course in accordance with AASHTO T 230. Take three cores at location designated by Contracting Officer for each 200 tons, or fraction thereof, of asphalt placed. Deliver cores undisturbed and undamaged to laboratory and provide test results within 48 hours of each day placement of paving materials.

b. Thickness: Determine thickness of the binder and wearing course from cores taken for density test.

c. Straightedge Test: Test compacted surface of binder course and wearing course with a straightedge as work progresses. Apply straightedge parallel with and at right angles to center line after final rolling. Variations in the binder course surface shall not be more than 1/4 inches from the lower edge of the 10 foot straightedge; variations in wearing course surface shall not be more than 1/4 from the lower edge of the 10 foot straightedge. Variations in final pervious surface shall not be more than 3/8 inch under a 10 foot straightedge. Pavement showing irregularities greater than that specified shall be corrected as directed by Contracting Officer.

3.3.2.3 Alternate Testing Method for Pavement Courses

At Contractor's option the following in-place testing method may be used to determine density and thickness in lieu of testing specified above. Frequency of testing shall be the same. When in-place nuclear method to determine density is used, take two pavement cores at locations designated by Contracting Officer and turn over to Government to verify pavement thickness.

a. Density: Determine density of pavement by in-place testing using Nuclear Method in accordance with ASTM D 2950.

b. Thickness: Determine thickness of finished pavement by use of following equation:

$$t = \frac{W}{0.75d}$$

Where t= pavement thickness, in inches.
W= average weight per square yard of mixture actually used in work.
d= compacted density as measured by nuclear density device.

3.4 WASTE MANAGEMENT

Protect excess material from contamination and return to manufacturer, or reuse on-site for walkways, patching, ditch beds, speed bumps, or curbs.

-- End of Section --

SECTION 32 11 24

GRADED CRUSHED AGGREGATE BASE COURSE FOR FLEXIBLE PAVEMENT

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(2006)Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 29/C 29M	(2007) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1883	(2007) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2217	(1985; R 1998) Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D 2922	(2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 75	(2003) Standard Practice for Sampling

Aggregates

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 RELATED SECTIONS

Pervious pavement systems shall use Section 32 11 16.16 SUBBASE COURSE FOR PERVIOUS PAVING, and Section 32 13 13.06 PERVIOUS PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES or Sections 32 10 00 PERVIOUS BITUMINOUS CONCRETE PAVEMENT and 32 12 10 BITUMINOUS TACK AND PRIME COATS, in addition to this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Aggregates; (LEED)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

Local/Regional Materials; (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

SD-06 Test Reports

Gradation

Bearing ratio

Liquid limit

Plasticity index

Percentage of wear

Density

Gradation

Smoothness

Density

Thickness

1.4 DELIVERY AND STORAGE

Inspect materials delivered to site for damage and store as to prevent segregation and contamination.

1.5 WEATHER LIMITATIONS

Do not construct base course when atmospheric temperature is below 35 degrees F or when rainfall or other weather conditions detrimentally affect the quality of the finished course.

1.6 CONSTRUCTION EQUIPMENT

Equipment shall be dependable and adequate for the purpose intended. Maintain equipment in satisfactory and safe operating condition. Subject to approval, special equipment dictated by local conditions may be used. Calibrated equipment, such as scales, batching equipment, spreaders, and similar items, shall have been recalibrated by an approved calibration laboratory or a State calibration laboratory within 12 months of commencing work.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Aggregate materials may be locally available.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aggregates

Consist of durable and sound crushed concrete, crushed masonry, crushed tile, crushed gravel, crushed stone, or crushed slag, free of lumps or balls of clay or other objectionable matter. Materials shall originate primarily from on-site construction waste, then from off-site construction waste, and finally from other nearby sources as needed. Crushed stone and gravel shall be free from flat, elongated, soft, or disintegrated pieces. Crushed gravel retained on a No. 4 sieve shall have at least 90 percent by weight with at least two fractured faces and 100 percent by weight with at least one fractured face. Base course materials samples shall have a bearing ratio of at least 100 as determined by laboratory tests on a 4-day soaked specimen in accordance with ASTM D 1883; compact specimen in accordance with ASTM D 1557, Method D. Determine grain size in accordance with ASTM C 136 and amount of material finer than 200 mesh sieve in accordance with ASTM C 117. Aggregate, other than slag, shall have a percentage of wear not exceeding 40, 45 when tested in accordance with ASTM C 131, Grading A. Slag shall be an air-cooled, blast furnace product having a dry weight of not less than 70, 65 pounds per cubic foot when tested in accordance with ASTM C 29/C 29M and shall consist of angular fragments uniform in density and quality, reasonably free from thin, elongated pieces, dirt, or other objectionable material. Soil binder

material, that portion of material passing the No. 40 sieve, shall be of such composition that the composite material conforms to the requirements specified herein. The base course shall be of such nature that it can be compacted readily with watering and rolling to a firm, stable base and shall conform to one of the following sizes:

Percentage by Weight Passing
Square Mesh Laboratory Sieves

Sieves	Size Numbers 1	2	3
2 inch	100	-	-
1 1/2 inch	70-100	100	-
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-10	0-10	0-10

That portion of the material passing the No. 40sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 as determined by ASTM D 4318. Prepare samples in accordance with ASTM D 2217, Procedure A.

PART 3 EXECUTION

3.1 BASE COURSE

Construct the graded aggregate base course on a prepared subgrade, as indicated. Verify compacted subgrade, granular base, or stabilized soil is acceptable and ready to support paving and imposed loads. Provide line and grade stakes for control. Place grade stakes in lanes parallel to the centerline of areas to be paved and space for string lining or other control methods. The base course shall consist of aggregate processed, deposited, spread, and compacted on a prepared surface. The Contractor shall be responsible for protection of completed areas against detrimental effects. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions.

3.2 PLACING

Do not dump mixed materials in piles, but place on prepared subgrade or subbase in layers of uniform thickness with a spreader. When a compacted course 6 inches in thickness is required, place material in a single layer. When a compacted course in excess of 6 inches is required, place material in layers of equal thickness. Do not exceed 6 inches or have less than 3 inches in thickness for any compacted layer. Place layers so that when compacted, they will be true to grades or levels required with the least possible surface disturbance. Where the base course is constructed in more than one layer, clean previously constructed layers of loose and foreign matter. Maintain material water content during the placing period to obtain the compaction specified. Make adjustments in placing procedures or equipment to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to insure a satisfactory base course.

3.3 COMPACTING AND FINISHING

Immediately following the placing, spread the finished mixture uniformly in a layer and bring to optimum moisture content. The loose thickness and the surface of the layer shall be such that the specified density and the required thickness shall be obtained after compaction. Compact the layer with steel-faced, vibrating or pneumatic-tired rollers, or other suitable compacting equipment or combinations thereof. Continue compacting until the layer is compacted through the full depth to a field density of at least 100 percent of the maximum density at optimum moisture content tested in accordance with ASTM D 1556 ASTM D 2922 and ASTM D 3017. In areas not accessible to rollers or compactors, compact the mixture with mechanical hand tampers. If the mixture is excessively moistened by rain, aerate by blade graders, or other suitable equipment. Aerate until the moisture content of the material is that needed to obtain the required density. Finish the surface of the layer by a combination of rolling and blading. Final surface shall be smooth and free from waves, irregularities, and ruts or soft yielding spots.

3.4 PROOF ROLLING

On the center 25 feet of taxiways and on the center 100 feet of runways, in addition to compacting the base course to the required density, proof roll the top surface of the completed base course by making eight coverages with a heavy rubber-tired roller having four tires with each tire loaded to 30,000 pounds or more and inflated to at least 150 psi. Make four coverages over other areas to be paved, excluding the runway over-runs, blast protection areas, and shoulders. A coverage is defined as one application of one tire print over each point in the surface of the designated area. When under the action of the proof rolling, the base course yields, pumps, or otherwise fails, remove, replace with suitable materials, and recompact materials in the base course or in the underlying layers indicated to be unsatisfactory. The speed of the roller shall not exceed 5 miles per hour. Obtain approval upon completion of the proof rolling of the base course.

3.5 FINISHING AT EDGES OF BASE COURSE

Place earth or other approved materials along the edges of the base course in such quantity that it will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, place material to the thickness of each layer. In each operation, allow at least a one foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer.

3.6 FIELD QUALITY CONTROL

Approve materials and material sources in advance of the use of such materials in the work. Replace base where samples are removed.

3.6.1 Sampling

3.6.1.1 Aggregates at the Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Repeat above sampling when source of material is changed or when unacceptable deficiencies or variations from

specified grading of materials are found in testing.

3.6.1.2 During Construction

Take one random sample from each 1000 tons of completed course material, but not less than one random sample per day's run. Take samples in accordance with ASTM D 75.

3.6.1.3 Sample Identification

Place each sample in a clean container, securely fastened to prevent loss of material. Tag each sample for identification and with the following information:

Contract No._____
Sample No._____ Quality _____
Date of Sample_____
Sampler_____
Source_____
Intended Use_____
For Testing_____

3.6.2 Testing

3.6.2.1 Aggregates

Test each sample of base course material without delay. Make gradation tests from each sample in accordance with ASTM C 136. Make sieve analysis on material passing the No. 200 sieve in accordance with ASTM C 117.

3.6.2.2 Smoothness Tests

Test with a 10 foot straightedge, applied parallel with and at right angles to the center line of the paved area. Correct deviations in the surface in excess of 1/2 inch by loosening, adding or removing material, reshaping, watering, and compacting. The smoothness requirements specified herein apply only to the top layer when base course is constructed in more than one layer.

3.6.2.3 Field Density Tests

ASTM D 1556 or ASTM D 2922 and ASTM D 3017. Take one test for each 500 square yards of each layer of base course.

3.6.2.4 Laboratory Density Tests

In accordance with ASTM D 1557, Method D.

3.6.2.5 Thickness Tests

Measure thickness of base course at intervals such that there will be a depth measurement for at least each 500 square yards of complete base course. Make depth measurements by test holes, at least 3 inches in diameter, through the base course. Where base course deficiency is more than 1/2 inch, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness is more than 1/2 inch thicker than indicated, consider it as the indicated thickness plus 1/2 inch for determining the average. The average thickness is the average of the depth measurements and shall not underrun the thickness indicated.

3.7 MAINTENANCE

After construction is completed, maintain the base course throughout, except where portion of the succeeding course is under construction thereon. Maintenance includes drainage, rolling, shaping, and watering, as necessary, to maintain the course in proper condition. Correct deficiencies in thickness, composition, construction, smoothness, and density, which develop during the maintenance, to conform to the requirements specified herein. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

-- End of Section --

SECTION 32 12 10

BITUMINOUS TACK AND PRIME COATS

10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 20	(1970; R 2004) Penetration-Graded Asphalt Cement
AASHTO M 226	(1980; R 2004) Viscosity Graded Asphalt Cement
AASHTO M 81	(1992; R 2004) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO M 82	(1975; R 2004) Cut-Back Asphalt (Medium-Curing Type)
AASHTO T 102	(1983; R 2004) Spot Test of Asphaltic Materials

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1250	(2007) Standard Guide for Use of the Petroleum Measurement Tables
ASTM D 2026	(1997; R 2004) Cutback Asphalt (Slow-Curing Type)
ASTM D 2027	(1997; R 2004) Cutback Asphalt (Medium-Curing Type)
ASTM D 2028	(1997; R 2004) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2397	(2005) Standard Specification for Cationic Emulsified Asphalt
ASTM D 3381	(2005) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 946	(1982; R 2005) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 977	(2005) Emulsified Asphalt

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

Waybills and delivery tickets, during progress of the work.

Local/Regional Materials; (LEED)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

SD-06 Test Reports

Sampling and Testing

Copies of all test results for emulsified asphalt, and bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating temperature viscosity relationship for cutback asphalt, compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.3 UNIT PRICES

1.3.1 Measurement

The bituminous material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10 percent over the specified application rate. Any amount of bituminous material more than 10 percent over the specified application rate for each application shall be deducted from the measured quantities, except for irregular areas where hand spraying of the bituminous material is necessary. Measured quantities shall be expressed in 2000 pound tons gallons at 60 degrees F. Volumes measured at temperatures other than 60 degrees F shall be corrected in accordance with ASTM D 1250, using a coefficient of expansion of 0.00025 per degree F for asphalt emulsion.

1.3.2 Payment

The quantities of bituminous material, determined as specified above, will be paid for at the respective contract unit prices. Payment shall constitute full compensation for all operations necessary to complete the work as specified herein.

1.3.3 Waybills and Delivery Tickets

Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered by the contract. These submittals are required for Unit Pricing bid only. The Contractor shall not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

1.4 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines and tools used in the work are subject to approval and must be maintained in a satisfactory working condition at all times. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by a calibration laboratory within 12 months prior to commencing work.

1.4.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number that the load produced on the base surface does not exceed 650 psi of tire width and to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process.

1.4.3 Heating Equipment for Storage Tanks

The equipment for heating the bituminous material shall be steam, electric, or hot oil heaters. Steam heaters shall consist of steam coils and equipment for producing steam, so designed that the steam cannot get into the material. Fix an armored thermometer to the tank with a temperature range from 40 to 400 degrees F so that the temperature of the bituminous material may be determined at all times.

1.4.4 Power Brooms and Power Blowers

Use power brooms and power blowers suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.5 WEATHER LIMITATIONS

Apply bituminous coat only when the surface to receive the bituminous coat is dry. Apply bituminous coat only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application, unless otherwise

directed.

1.6 DELIVERY AND STORAGE

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

Use Local/Regional Materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Tack and prime coat materials may be locally available.

PART 2 PRODUCTS

2.1 PRIME COAT

Asphalt shall conform to AASHTO M 81, AASHTO M 82, Grade _____ and specified in the following two subparagraphs.

2.1.1 Cutback Asphalt

Cutback asphalt shall conform to ASTM D 2026, Grade SC-70 ASTM D 2027, Grade MC-30, MC-70 ASTM D 2028, Grade RC-70.

2.1.2 Emulsified Asphalt

Emulsified asphalt shall conform to ASTM D 977, Type SS-1, SS1h ASTM D 2397, Type CSS-1, CSS-1h.

2.2 TACK COAT

Asphalt shall conform to ASTM D 2028, ASTM D 946, ASTM D 3381, ASTM D 977, ASTM D 2397, or AASHTO M 81, AASHTO M 20, AASHTO M 226 Grade _____.

2.2.1 Cutback Asphalt

Cutback asphalt shall conform to ASTM D 2026, Grade SC-70 ASTM D 2027, Grade MC-30, MC-70 ASTM D 2028, Grade RC-70.

2.2.2 Emulsified Asphalt

Emulsified asphalt shall conform to ASTM D 977, Type SS-1, SS1h ASTM D 2397, Type CSS-1, CSS-1h. Dilute the emulsified asphalt with equal parts of water. The base asphalt used to manufacture the emulsion shall show a negative spot when tested in accordance with AASHTO T 102 using standard naphtha.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated by means of a power broom or blower supplemented with hand brooms. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Apply bituminous material for the tack coat in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

3.2.2 Prime Coat

Apply bituminous material for the prime coat in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. Furnish the temperature viscosity relation to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts

SC-70	120-225 degrees F
SC-250	165-270 degrees F
MC-30	85-190 degrees F
MC-70	120-225 degrees F
MC-250	165-270 degrees F
RC-70	120-200 degrees F*
RC-250	165-250 degrees F*

Paving Grade Asphalts

Penetration Grades

200-300	plus 265 degrees F
120-150	plus 270 degrees F
85-100	plus 280 degrees F

Viscosity Grades

AC 2.5	plus 270 degrees F
AC 5	plus 280 degrees F
AC 10	plus 280 degrees F
AR 1000	plus 275 degrees F
AR 2000	plus 285 degrees F

AR 4000	plus 290 degrees F
Emulsions	
RS-1	70-140 degrees F
MS-1	70-160 degrees F
HFMS-1	70-160 degrees F
SS-1	70-160 degrees F
SS-1h	70-160 degrees F
CRS-1	125-185 degrees F
CSS-1	70-160 degrees F
CSS-1h	70-160 degrees F

*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, apply the bituminous prime or tack coat with the Bituminous Distributor at the specified rate with uniform distribution over the surface to be treated. Properly treat all areas and spots missed by the distributor with the hand spray. Until the succeeding layer of pavement is placed, maintain the surface by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, spread clean dry sand to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment are permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. Prevent all traffic, except for paving equipment used in constructing the surfacing, from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

3.4.2 Prime Coat

The prime coat is required if it will be at least 7 days before the surfacing layer is constructed on the underlying (base course, etc.) compacted material. The type of liquid asphalt and application rate will be as specified herein. Protect the underlying from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Repair (recompact or replace) damage to the underlying material caused by lack of, or inadequate, protection by approved methods at no additional cost to the Government. If the Contractor options to use the prime coat, apply as soon as possible after consolidation of the underlying material. Apply the bituminous material uniformly over the surface to be treated at a pressure range of 25 to 75 psi and at the rate of not less than 0.20 gallon not more than 0.30 gallon per square yard. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, spread building paper on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application remove and destroy the building paper.

3.4.3 Tack Coat

Apply the tack coat when the surface to be treated is dry. Immediately following the preparation of the surface for treatment, apply the bituminous material by means of the bituminous distributor, within the limits of temperature specified herein and at a rate of not less than 0.05 gallon nor more than 0.15 gallon of diluted emulsion per square yard. Apply the bituminous material so that uniform distribution is obtained over the entire surface to be treated. Treat lightly coated areas and spots missed by the distributor with the bituminous material. Following the application of bituminous material, allow the surface to cure without being disturbed for period of time necessary to permit setting of the tack coat. Apply the bituminous tack coat only as far in advance of the placing of the overlying layer as required for that day's operation. Maintain and protect the treated surface from damage until the succeeding course of pavement is placed.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread enough sand to effectively blot up and cure excess bituminous material.

3.6 TRIAL APPLICATIONS

Before providing the complete bituminous coat, apply three lengths of at least 100 feet for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied.

3.6.1 Tack Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous tack coat materials in the amount of 0.05 gallons per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.6.2 Prime Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous materials in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.6.3 Sampling and Testing During Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL.

3.7 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

-- End of Section --

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 116	(2005) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 702	(1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780	(2001; R 2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 90/A 90M	(2007) Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM B 117	(2007) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 94/C 94M	(2007) Standard Specification for Ready-Mixed Concrete
ASTM F 1043	(2006) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(2006) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F 567	(2007) Standard Practice for Installation of Chain Link Fence
ASTM F 626	(1996a; R 2003) Standard Specification for Fence Fittings
ASTM F 883	(2004) Padlocks

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191	(Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories)
FS RR-F-191/1	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric)
FS RR-F-191/2	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Gates)
FS RR-F-191/3	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)
FS RR-F-191/4	(Rev D) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Erection/Installation Drawings for the following items in accordance with paragraph entitled, "Assembly and Installations Instructions," of this section.

Fence Assembly
Location of Gate, Corner, End, and Pull Posts
Gate Assembly
Gate Hardware and Accessories

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Fence Assembly
Gate Assembly
Gate Hardware and Accessories

SD-04 Samples

Contractor must submit the following samples described within this section:

Fabric
Posts
Braces
Line Posts
Sleeves
Top Rail
Bottom Rail

Tension Wire
Stretcher Bars
Gate Posts
Gate Hardware and Accessories
Padlocks
Wire Ties

SD-07 Certificates

Submit Certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following items:

Zinc Coating
PVC coating
aluminum alloy coating
Fabric
Stretcher Bars
Gate Hardware and Accessories
Concrete

SD-08 Manufacturer's Instructions

Submit Manufacturer's instructions for the following items:

Fence Assembly
Gate Assembly
Hardware Assembly
Accessories

1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Contractor must provide manufacturer's instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Submit Erection/Installation drawings along with manufacturer's catalog data for Complete fence assembly, gate assembly, hardware assembly and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating, thickness of PVC coating, and chemical composition and thickness of aluminum alloy coating.

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials that conform to the requirements of ASTM A 116, ASTM A 702, ASTM F 626, and as specified.

2.2 ZINC COATING

Ferrous-metal components and accessories, except as otherwise specified, must be hot-dip galvanized after fabrication.

Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A 90/A 90M.

Provide zinc coating that conforms to the requirements of the following:

Pipe: FS RR-F-191/3 Class 1 Grade A in accordance with ASTM F 1083 Grade B in accordance with ASTM F 1043.

Hardware and accessories: ASTM A 153/A 153M, Table 1

Surface (ASTM F 1043):

External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.

Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A 780.

2.3 FABRIC

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

FS RR-F-191/1; Type I, zinc-coated steel. Mesh size, 2 inches. Provide selvage knuckled at one selvage and twisted and barbed at the other. Fabric must consist of No. 9-gage wires woven diamond mesh, with dimensions of fabric and wire conforming to ASTM A 116, ASTM A 702 and ASTM F 626, with 1.29 ounces per square foot zinc galvanizing.

Fence heights to 12 feet must have one-piece fabric widths.

2.4 TOP AND BOTTOM SELVAGES

Fabric with 2 inch mesh and up to 60 inches high must be knuckled on both top and bottom selvages, over if 60 inches high, it must be twisted and barbed on the top selvage and knuckled on the bottom selvage.

Knuckle top and bottom selvages for 1-3/4-inch and 1-inch mesh fabric.

2.5 POSTS, TOP RAILS, BOTTOM RAILS AND BRACES

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A or B galvanized. End, corner, and pull posts; Class 1, steel pipe, Grade A or B. Braces and rails; Class 1, steel pipe, Grade A or B. Steel pipe, Class 1, Grade B must meet the following performance criteria when subjected to salt spray testing in accordance with ASTM B 117:

a. Exterior 1,000 hours with maximum 5 percent red rust.

b. Interior 650 hours with maximum 5 percent red rust.

2.6 LINE POSTS

Minimum acceptable line posts must be as follows:

Up to 6-feet high:

Grade A: 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6-feet high:

2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

2.7 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade A: 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6 feet high:

Grade A: 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

Grade B: 2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

2.8 SLEEVES

Provide sleeves for setting into concrete construction of the same material as post sections. Size must be 1-inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.9 TOP RAIL

Rails must be a minimum of 1.660 inches O.D. pipe Grade A weighing 2.27 pounds per linear foot. Provide expansion couplings 6-inches long at each joint in top rails.

2.10 CENTER RAILS BETWEEN LINE POSTS

For fencing over 6-feet high, center rails must be 1.660 inches O.D. pipe Grade A weighing 2.27 pounds per linear foot.

2.11 BOTTOM RAIL

Bottom Rail must conform to minimum sizes specified in FS RR-F-191/3 for each class and grade unless members are to be oversized.

2.12 POST-BRACE ASSEMBLY

Bracing must consist of 1.660 inches O.D. pipe Grade A weighing 2.27 pounds per linear foot or Grade B weighing 1.82 pounds per linear foot and 3/8 inch adjustable truss rods and turnbuckles.

2.13 TENSION WIRE

Wire must be galvanized, No. 7-gage, coiled spring wire, provided at the bottom of the fabric only. Provide Zinc Coating that weighs not less than 1.6 ounces per square foot.

2.14 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A 116, ASTM A 702 and ASTM F 626.

2.15 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Caps must have an opening to permit through passage of the top rail.

2.16 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.17 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Up to 6-feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot. Grade B weighing 4.64 pounds per linear foot.

Over 6 feet wide and up to 13 feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot. Grade B weighing 4.64 pounds per linear foot.

Over 13-feet and up to 18-feet wide:

Provide 6.625 inch O.D. pipe weighing 18.97 pounds per linear foot.

Over 18-feet wide:

Provide 8.625 inch O.D. pipe weighing 24.70 pounds per linear foot.

2.18 GATES

FS RR-F-191/2; Type I, single swing, II, double swing, III, single cantilever sliding, wheel sliding gate, IV, double cantilever sliding, V, single overhead sliding, VI, double overhead sliding. Shape and size of gate frame, as indicated. Framing and bracing members, round of steel alloy. Steel member finish, zinc-coated. Gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade except that steel pipe frames must be 1.90 inches od, 0.120 inches minimum wall thickness and intermediate braces must be 1.869 inches od, 0.940 lb/ft of

length. Gate fabric, as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized Gate latches, fork, plunger bar type. Special gate frames, as indicated. Gate leaves more than 8 feet wide must have intermediate members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide must have truss rods or intermediate braces. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding is not permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

For gate leaves up to 6-feet high or 6-feet wide, perimeter gate frames must be 1.66 inch O.D. pipe Grade A weighing 2.27 pounds per linear foot.

For gate leaves over 6 feet high or 6 feet wide, perimeter gate frames must be 1.90 inch O.D. pipe Grade A weighing 2.72 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, must be provided where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.19 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A 116, ASTM A 702, ASTM F 626, and be as specified:

Provide malleable iron, forged steel, pressed steel hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

Provide double gates with a cane bolt and ground-set keeper, with latch or locking device and padlock eye designed as an integral part.

Provide manufacturer's standard heavy-duty track ball bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required for easy operation of manual sliding gates.

2.20 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.21 WIRE TIES

Wires for tying fabric to line posts must be 16-gage galvanized steel wire spaced 12 inches on center. For tying fabric to rails and braces, wire

ties must be spaced 24 inches on center. For tying fabric to tension wire, 0.105-inch hog rings must be spaced 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric. Provide accessories with polyvinyl (PVC) coatings similar to that specified for chain-link fabric or framework.

2.22 CONCRETE

Provide concrete conforming to ASTM C 94/C 94M. Concrete mix must obtain a minimum 28-day compressive strength of 3,000 psi.

2.23 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.24 PADLOCKS

Provide padlocks conforming to ASTM F 883, with chain.

PART 3 EXECUTION

Completed installation must conform to ASTM F 567.

3.1 GENERAL

Final grading and established elevations must be complete prior to commencing fence installation.

3.2 EXCAVATION

Excavations for post footings must be drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 10 feet on center maximum and at closer intervals when indicated.

Bottoms of the holes must be approximately 3-inches below the bottoms of the posts. Set bottom of each post not less than 36-inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Soil from excavations must be spread uniformly adjacent to the fence line or on areas of Government property, as directed, removed from Government property.

When solid rock is encountered near the surface, the Contractor must drill into the rock at least 12 inches for line posts and at least 18 inches for end, pull, corner, and gate posts. Drill holes at least 1 inch greater in diameter than the largest dimension of the placed post.

If solid rock is below the soil overburden, Contractor must drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Remove loose and foreign materials from holes and the soil moistened prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Posts set into sleeved holes in concrete must be grouted in with an approved grouting material.

Posts set in concrete construction must be set vertically, with tops aligned and held in position until concrete has set.

3.3.1 Earth and Bedrock

Provide concrete bases of dimensions indicated, except in bedrock. Compact concrete to eliminate voids, and finish to a dome shape. In bedrock, set posts with a minimum of 1 inch of grout around each post. Work grout into hole to eliminate voids, and finish to a dome shape.

3.3.2 Concrete Slabs and Walls

Set posts into zinc-coated sleeves, set in concrete slab or wall, to a minimum depth of 12 inches. Fill sleeve joint with lead, nonshrink grout, or other approved material. Set posts for support of removable fence sections into sleeves that provide a tight sliding joint and hold posts aligned and plumb without use of lead or setting material.

3.3.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal truss rod and truss tightener used as a tension member, two diagonal truss rods and truss tighteners used as tension members.

3.4 CONCRETE STRENGTH

Provide Concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Fabric and wires must not be stretched or gates hung until the concrete has attained its full design strength.

Samples and test concrete must be taken to determine strength as specified.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 CENTER RAILS

Center rails must be one piece between posts set flush with posts on the fabric side, using special offset fittings where necessary.

3.7 BRACE ASSEMBLY

Contractor must provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.8 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

3.9 FABRIC INSTALLATION

Provide Fabric in single lengths between stretch bars with bottom barbs placed approximately 1-1/2-inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Fabric must remain under tension after the pulling force is released.

3.10 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.11 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.12 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.13 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.14 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and

cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.15 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.16 SITE PREPARATION

3.16.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.17 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.17.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feeton center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.17.2 Top and Bottom Tension Wire

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.18 ACCESSORIES INSTALLATION

3.18.1 Post Caps

Design post caps to accommodate top rail. Install post caps as recommended by the manufacturer.

3.18.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.19 GROUNDING

Ground fencing as indicated on drawings and specified.

Fences crossed by overhead powerlines in excess of 600 volts must be grounded. Electrical equipment attached to the fence must be grounded. Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations must not exceed 650 feet. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by powerlines of 600 volts or more at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Ground conductor must consist of No. 8 AWG solid copper wire. Grounding electrodes must be 3/4 inch by 10 foot long copper-clad steel rod. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, electrodes must be buried a minimum of 12 inches deep and radially from the fence. The top of the electrode must be not less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground must not be greater than 25 ohms.

3.20 SECURITY

Install new security fencing, remove existing security fencing, and perform related work to provide continuous security for facility. Schedule and fully coordinate work with Contracting Officer and cognizant Security Officer.

3.21 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --

SECTION 32 92 19

SEEDING

10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (2007) Agricultural Liming Materials

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, Section 32 92 23 SODDING applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wood cellulose fiber mulch

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

SD-07 Certificates

State certification and approval for seed

SD-08 Manufacturer's Instructions

Erosion Control Materials

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer and Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified, State-approved, Endophyte-enhanced seed of the

latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

2.1.2 Planting Dates

Planting Season	Planting Dates
Season 1	March 1 - August 31
Season 2	September 1 - February 28
Temporary Seeding	Throughout year to stabalize soil

2.1.3 Seed Purity

Botanical Name	Common Name	Min. Percent Pure Seed	Min. Percent Germination and Hard Seed	Max. Percent Weed Seed
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

2.1.4 Seed Mixture by Weight

Planting Season	Variety	Pounds Per Acre
Season 1	Tall Fescue	50 pound
	Centipede	5 pound
	Bermuda Grass/Hulled	25 pound
Season 2	Tall Fescue	50 pound
	Centipede	5 pound
	Bermuda Grass/Unhulled	35 pound
Temporary Seeding	German Millet (Summer)	50 pound
	Rye Grass (Winter)	50 pound

Proportion seed mixtures by weight. Temporary seeding must later be replaced by Season 1, Season 2 plantings for a permanent stand of grass.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00 EARTHWORK or 31 23 00.00 20 EXCAVATION AND FILL.

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade hydrate limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Synthetic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

10 percent available nitrogen
20 percent available phosphorus
20 percent available potassium

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contrain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.

2.6 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

2.7 EROSION CONTROL MATERIALS

Erosion control material shall conform to the following:

2.7.1 Erosion Control Blanket

100 percent agricultural straw, 70 percent agricultural staw/30 percent coconut fiber matrix stitched with a degradable nettings, designed to degrade within 12 months, 18 months.

2.7.2 Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.7.3 Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.7.4 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of on-site topsoil or existing soil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer and pH adjusters into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Lime 500 pounds per acre

3.1.1.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Synthetic Fertilizer 4000 pounds per acre

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method shall be broadcasted and drop seeding.

3.2.2.1 Broadcast and Drop Seeding

Seed shall be uniformly broadcast at the rate of 80 or 90pounds per acre. Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.2.2 Drill Seeding

Seed shall be drilled at the rate of 80 or 90 pounds per acre. Use cultipacker seeders or grass seed drills. Drill seed uniformly to average depth of 1/2 inch.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.2.3.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.2.5 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Contracting Officer.

3.2.6 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RENOVATION OF EXISTING TURF AREA

3.4.1 Aeration

Upon completion of weed eradication operations and Contracting Officer's approval to proceed, aerate turf areas indicated , by approved device. Core, by pulling soil plugs, to a minimum depth of 3 inches. Leave all soil plugs, that are produced, in the turf area. After aeration operations are complete, topdress entire area 1/4 inch depth with the following mixture:

_____ percent sand
_____ percent humus
_____ percent gypsum
_____ percent organic fertilizer
synthetic fertilizer: 16-8-8, 500 pound per acre

Blend all parts of topdressing mixture to a uniform consistency throughout. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean all soil plugs off of other paving when work is complete.

3.4.2 Vertical Mowing

Upon completion of aerating operation and Contracting Officer's approval to proceed, vertical mow turf areas indicated, by approved device, to a depth of 1/2 inch above existing soil level, to reduce thatch build-up, grain, and surface compaction. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work is complete. Remove all debris generated during this operation off site.

3.4.3 Overseeding

Apply seed in accordance with applicable portions of paragraph entitled "Seed Application Method" at rates in accordance with paragraph entitled "Seed Composition."

3.5 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 32 92 23

SODDING

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

TURFGRASS PRODUCERS INTERNATIONAL (TPI)

TPI GSS	(1995) Guideline Specifications to Turfgrass Sodding

1.2 DEFINITIONS

1.2.1 Stand of Turf

100 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK and Section 32 92 19 SEEDING, applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

SD-07 Certificates

Sod farm certification for sods. Indicate type of sod in accordance with TPI GSS.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Sod Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Sod Storage

Lightly sprinkle with water, cover with moist burlap, straw, or other approved covering; and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that internal heat will not develop. Do not store sod longer than 24 hours. Do not store directly on concrete or bituminous surfaces.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Sod

Place sod a maximum of thirty six hours after initial harvesting, in accordance with TPI GSS as modified herein.

PART 2 PRODUCTS

2.1 SODS

2.1.1 Classification

Nursery grown, certified as classified in the TPI GSS. Machine cut sod at a uniform thickness of 3/4 inch within a tolerance of 1/4 inch, excluding

top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will be rejected.Wood pegs and wire staples for anchorage shall be as recommended by sod supplier.

2.1.2 Purity

Sod species shall be genetically pure, free of weeds, pests, and disease.

2.1.3 Composition

2.1.3.1 Proportion

Proportion grass species as follows.

Botanical Name	Common Name	Percent:
_____	Centipede	100%
_____	_____	_____

2.2 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3 FERTILIZER

2.3.1 Granular Fertilizer

Synthetic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

10 percent available nitrogen
10 percent available phosphorus
10 percent available potassium

2.4 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation containing no element toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners), fertilizing, and sodding of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.2 Soil Preparation

After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface

after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.2.1 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Synthetic Granular Fertilizer 500 pounds per acre .

3.2 SODDING

3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 31 00 00 EARTHWORK, 31 23 00.00 20 EXCAVATION AND FILL.

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove from the surface debris and stones over a minimum 5/8 inch in any dimension.

3.2.2 Placing

Place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS as modified herein.

3.2.3 Sodding Slopes and Ditches

For slopes 2:1 and greater, lay sod with long edge perpendicular to the contour. For V-ditches and flat bottomed ditches, lay sod with long edge perpendicular to flow of water. Anchor each piece of sod with wood pegs or wire staples maximum 2 feet on center. On slope areas, start sodding at bottom of the slope.

3.2.4 Finishing

After completing sodding, blend edges of sodded area smoothly into surrounding area. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed and holes and missing corners shall be patched with sod.

3.2.5 Rolling

Immediately after sodding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.2.6 Watering

Start watering areas sodded as required by daily temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to minimum depth of 6 inches. Run-off, puddling, and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or plant material shall

be prevented.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RENOVATION OF EXISTING TURF AREA

3.4.1 Vertical Mowing

Upon completion of aerating operation and Contracting Officer's approval to proceed, vertical mow turf areas indicated, by approved device, to a depth of 1/2 inch above existing soil level, to reduce thatch build-up, grain, and surface compaction. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work is complete. Remove all debris generated during this operation off site.

3.5 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 33 11 00

WATER DISTRIBUTION

10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	(2007) Manual for Railway Engineering

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C104/A21.4	(2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2005) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2003) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C203	(2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C500	(2002; R 2003) Metal-Seated Gate Valves

	for Water Supply Service
AWWA C502	(2005) Dry-Barrel Fire Hydrants
AWWA C503	(2005) Wet-Barrel Fire Hydrants
AWWA C504	(2006) Standard for Rubber-Seated Butterfly Valves
AWWA C508	(2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C700	(2002; R 2003) Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(2007) Standard for Cold-Water Meters - Turbine Type for Customer Service
AWWA C702	(2001) Cold-Water Meters - Compound Type
AWWA C703	(1996; R 2004) Cold-Water Meters - Fire Service Type
AWWA C704	(2002) Propeller-Type Meters for Waterworks Applications
AWWA C706	(1996; R 2005) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C707	(2005) Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	(2005) Underground Service Line Valves and Fittings
AWWA C900	(2007) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA C901	(2002) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13mm) Through 3 In. (76 mm), for Water Service

AWWA C905	(1997) Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 In. Through 48 In. (350 mm through 1,200 mm)
AWWA C906	(2007) Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In., (1,575 mm) for Water Distribution and Transmission
AWWA C909	(2002) Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 IN through 12 IN (100 mm Through 300 mm), for Water Distribution
AWWA M11	(2004) Manual: Steel Pipe: A Guide for Design and Installation
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation
AWWA M9	(1995) Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.15	(2006) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts (Inch Series)
ASME B18.5.2.1M	(2006) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2005) Metric Round Head Square Neck Bolts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 47/A 47M	(1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 746	(2003) Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM B 42	(2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B 61	(2002) Standard Specification for Steam or Valve Bronze Castings
ASTM B 62	(2002) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM C 94/C 94M	(2007) Standard Specification for Ready-Mixed Concrete
ASTM D 1784	(2007) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM F 1483	(2005) Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe
ASTM F 477	(2007) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(2006) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 325	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 49	(2003) Hazardous Chemicals Data
NFPA 704	(2006) Identification of the Hazards of Materials for Emergency Response

UNDERWRITERS LABORATORIES (UL)

UL 246	(1993; Rev thru Dec 1998) Hydrants for Fire-Protection Service
UL 262	(2004) Standard for Gate Valves for Fire-Protection Service
UL 312	(2004) Check Valves for Fire-Protection Service
UL 789	(2004) Indicator Posts for Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)
UBPPA UNI-B-8	(2000) Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe (Nominal Diameters 6-12 Inch)

1.2 UNIT PRICES

Measurement and payment will be based on completed work performed in accordance with the drawings, specifications, and the contract payment schedules. Payment will not be made under this section for excavation, trenching, or backfilling.

1.2.1 Measurement

The length of water lines to be paid for will be determined by measuring along the centerlines of the various sizes of pipe furnished and installed. Pipe will be measured from center of fitting to center of fitting, from center of water distribution line to end of service connection, and from center of water distribution line to center of hydrant. No deduction will be made for the space occupied by valves or fittings.

1.2.2 Payment

Payment will be made for water lines at the contract unit price per linear foot for the various types and sizes of water lines, and will be full compensation for all pipes, joints, specials, and fittings, complete in place. Payment for fire hydrants, gate valves, valve boxes, and standard valve manholes will be made at the respective contract unit price each for such items complete in place. Payment will include the furnishing of all testing, plant, labor, and material and incidentals necessary to complete the work, as specified and as shown.

1.3 DESIGN REQUIREMENTS

1.3.1 Water Distribution Mains

Provide water distribution mains indicated as 4 through 10 inch diameter pipe sizes of ductile-iron or C 900, Dr 18 polyvinyl chloride (PVC) plastic pipe. Provide ductile iron or C 903, Dr 18 pipe for 12 inch diameter or larger pipe sizes. Also provide water main accessories, gate valves and check valves, as specified and where indicated.

1.3.2 Water Service Lines

Provide water service lines indicated as _____ inch lines from water distribution main to building service at a point approximately 5 feet from building, the points indicated. Water service lines shall be copper pipe, copper tubing, polyvinyl chloride (PVC) plastic pipe or steel pipe. Ductile-iron or polyvinyl chloride (PVC) plastic pipe appurtenances, and valves as specified for water mains may also be used for service lines. Provide water service line appurtenances as specified and where indicated. Submit design calculations of water piping.

Provide water service lines indicated as less than 4 inch lines from water distribution main to building service at a point approximately 5 feet from building, the points indicated. Water service lines shall be copper tubing, polyvinyl chloride (PVC) plastic pipe. Provide water service line appurtenances as specified and where indicated.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and

coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Indicator posts

Corporation stops

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations of water piping

SD-06 Test Reports

Bacteriological Disinfection

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Shop-applied lining and coating

Lining

Fire hydrants

Displacement Type Meters

Compound Type Meters

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling

Installation procedures for water piping

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.5.2.1 Coated and Wrapped Steel Pipe

Handle steel pipe with coal-tar enamel, coal-tar epoxy coating in accordance with the provisions of AWWA C203.

1.5.2.2 Polyethylene (PE) Pipe, Fittings, and Accessories

Handle PE pipe, fittings, and accessories in accordance with AWWA C901.

1.5.2.3 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC), Reinforced Thermosetting Resin Pipe (RTRP) and Reinforced Mortar Pressure (RPMP) pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

a. Pipe and Fittings: Pipe, except flanged pipe, AWWA C151/A21.51, Pressure Class _____ Thickness Class _____. Flanged pipe,

AWWA C115/A21.15. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, twice the standard thickness.

b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints unless otherwise indicated. Provide mechanical joints where indicated. Provide flanged joints where indicated. Provide mechanically coupled type joints using a sleeve-type mechanical coupling where indicated. Provide grooved or shouldered type joints where indicated. Provide insulating joints where indicated. Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint, subject to the limitations specified in paragraph entitled "Sleeve-Type Mechanical Couplings." Grooved or shouldered type joints may be used in lieu of flanged joint or push-on joint, except where joint is buried.

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

(3) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

(4) Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated and zinc-coated steel. Gasket and lubricants for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

(5) Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

(6) Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

a. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) 200 (DR 14) with cast-iron-pipe-equivalent OD. Molecularly Oriented Polyvinyl Chloride (PVCO) pressurepipe, AWWA C909,shall be plain end or

gasket bell end, Pressure Class 150 with cast-iron-pipe-equivalent outside diameter.

b. Pipe 14 through 36 diameter: AWWA C905.

c. Fittings for PVC pipe: Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph. Iron fittings and specials shall be cement-mortar lined in accordance with AWWA C104/A21.4. Fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C605 and AWWA C900. Pipe, couplings and fittings for PVCO plastic pipe shall be manufactured of material conforming to ASTM F 1483 and ASTM D 1784, Class 12454-B. Schedule 80 PVC fittings shall conform to ASTM D 2467.

d. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.1.3 Polyethylene (PE) Plastic Piping

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C906.

2.1.1.4 Piping Beneath Railroad Right-of-Way

Piping passing under the right-of-way of a commercial railroad shall conform to the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5 of the AREMA Eng Man, except for casing pipe, provide ductile-iron pipe in lieu of cast-iron pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves on Buried Piping

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for

the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends or resilient-seated gate valves 2 to 12 inches in size, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of _____ psi, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals, except for those valves for which gearing is specified, in which case use conventional packing in place of 0-ring seal. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of mechanical-joint ends and push-on joint ends, valves may have special ends for connection to cement piping or to sleeve-type mechanical coupling. Valve ends and gaskets for connection to cement piping or to sleeve-type mechanical coupling shall conform to the applicable requirements specified respectively for the joint or coupling. Where a post indicator is shown, the valve shall have an indicator post flange; indicator post flange for AWWA C500 valve shall conform to the applicable requirements of UL 262. Provide _____ inch size valves with gearing and indicators, AWWA C500. Provide _____ inch size valves with bypasses, AWWA C500. Valves shall be of one manufacturer.

2.1.2.2 Gate Valves in Valve Pit(s) and Aboveground Location

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be outside-screw-and-yoke rising-stem, nonrising stem type with double-disc, solid-wedge gates and flanged ends, (2) AWWA C509 shall be outside-screw-and-yoke rising-stem, nonrising stem type with flanged ends, and (3) UL 262 shall be outside-screw-and-yoke, inside-screw type, shall have double-disc or split-wedge, solid or one-piece type gate and flanged ends, and shall be designed for a hydraulic working pressure of _____ psi. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves _____ inch size shall be nonrising stem type or inside-screw type where indicated. Valves _____ inch size shall have solid-wedge gates or solid or one-piece type gates where indicated. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of flanged ends, valves may have grooved or shouldered ends suitable for grooved or shouldered type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves _____ inch size shall have gearing and indicator, AWWA C500. Provide _____ inch size valve with bypasses, AWWA C500. Valves shall be of one manufacturer.

2.1.2.3 Check Valves

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have iron or steel body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends, and designed for a working pressure of _____ psi. Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. Valves shall be spring-loaded, weight-loaded, where indicated. Flanges shall be Class 125 conforming to ASME B16.1. In lieu of flanged ends, valves may have grooved or shouldered ends suitable for grooved or shouldered type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves shall be of one manufacturer.

2.1.2.4 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves 3 through 10 inches in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.1.2.5 Pressure Reducing Valves

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for _____ psi operating pressure on the inlet side, with outlet pressure set for _____ psi. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be threaded, flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.1.2.6 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.2.7 Fire Hydrants

Dry-barrel type or wet-barrel type, except that flush-type hydrants shall be provided where indicated. Paint hydrants with at least one coat of primer and two coats of yellow enamel paint, except use red enamel paint for tops of hydrants in non-potable water systems. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

a. Dry-Barrel Type and Wet-Barrel Type Fire Hydrants: Dry-barrel type hydrants, AWWA C502 or UL 246, "Base Valve" design, shall have 6 inch inlet, 5 1/4 inch valve opening, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Wet-barrel type hydrants, AWWA C503 or UL 246, "Wet Barrel" design, shall have 6 inch inlet, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Pumper connection and hose connections shall be individually valved with independent nozzle gate valves. Inlet shall have mechanical-joint or push-on joint end mechanical-joint end only, except where flanged end is indicated; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and

pumper connections shall be as specified in AWWA C502 or AWWA C503 or UL 246 indicated. Hydrants indicated as "traffic type," shall have frangible sections as mentioned in AWWA C502, breakable features as mentioned in AWWA C503. The traffic type hydrant shall have special couplings joining upper and lower sections of hydrant barrel and upper and lower sections of hydrant stem and shall be designed to have the special couplings break from a force not less than that which would be imposed by a moving vehicle; hydrant shall operate properly under normal conditions.

b. Flush-Type Fire Hydrants: Hydrants shall conform to the applicable requirements of AWWA C502, except that they shall be of a design that will permit placement of hydrant below surface of pavement. Hydrants shall have 6 inch inlet, 4 1/4 inch minimum valve opening, one 4 1/2 inch pumper connection, and one 2 1/2 inch hose connection. Hose and pumper connections and operating nuts shall be readily accessible, and enclosed in a cast iron box with top flush with pavement and having cast-iron cover with flush lifting handle. Inlet shall have mechanical-joint or push-on joint end, except where flanged end is indicated. Size and shape of operating nut and cap nuts and threads on hose and pumper connections shall be as specified in AWWA C502, indicated.

2.1.2.8 Indicator Posts

UL 789. Provide for gate valves where indicated.

2.1.2.9 Valve Boxes

Provide a valve box for each gate valve on buried piping, except where indicator post is shown. Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Cast-iron boxes shall have a minimum cover and wall thickness of 3/16 inch. Precast concrete boxes installed in locations subjected to vehicular traffic shall be designed to withstand the following AASHTO load designation as outline in AASHTO HB-17. Precast concrete boxes shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches, as indicated. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.2.10 Valve Pits

Valve pits shall be constructed at locations indicated or as required above and in accordance with the details shown.

2.1.2.11 Turbine Type Meters

Turbine type meters shall conform to AWWA C701 Class I, Class II. The main casing shall be bronze, cast iron protected by corrosion resistant coating with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed, open and shall read in U.S. gallons, cubic feet. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C701.

2.1.2.12 Propeller Type Meters

Propeller type meters shall conform to AWWA C704. Registers shall be straight-reading type, shall be permanently sealed, open and shall read in U.S. gallons cubic feet. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct-reading remote register designed in accordance with AWWA C706 or an encoder-type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C703.

2.1.2.13 Meter Vaults

Large meters shall be installed in reinforced concrete vaults manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. Large meters shall be installed in reinforced concrete vaults in accordance with the details shown on the drawings.

2.1.2.14 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron and PVC plastic pipe, the middle ring shall be of cast-iron or steel; and the follower rings shall be of malleable or ductile iron. For steel piping, the middle ring shall be of steel and the follower rings shall be of steel or malleable iron. Cast iron, ASTM A 48/A 48M not less than Class 25. Malleable and ductile iron shall, conform to ASTM A 47/A 47M and ASTM A 536, respectively. Steel shall have a strength not less than that of the pipe. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type, ASTM A 307, Grade A, with nuts, ASTM A 563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Bolts shall be 5/8 inch in diameter; minimum number of bolts for each coupling shall be _____ for _____ inch pipe, _____ for _____ inch pipe, and _____ for _____ inch pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Mechanical couplings shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.1.2.15 Bonded Joints

Where indicated. For all ferrous pipe, a metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous metallic piping to effect continuous conductivity. The bond wire shall be Size 1/0 copper conductor suitable

for direct burial shaped to stand clear of the joint. The bond shall be of the thermal weld type.

2.1.2.16 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of metallic or nonmetallic pipe.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Copper Pipe and Associated Fittings

Pipe, ASTM B 42, regular, threaded ends. Fittings shall be brass or bronze, ASME B16.15, 125 pound.

2.2.1.2 Copper Tubing and Associated Fittings

Tubing, ASTM B 88, Type K. Fittings for solder-type joint, ASME B16.18 or ASME B16.22; fittings for compression-type joint, ASME B16.26, flared tube type.

2.2.1.3 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

a. Polyvinyl Chloride (PVC) Plastic Piping with Screw Joints: ASTM D 1785, Schedule 40; or ASTM D 2241, with SDR as necessary to provide 150 psi minimum pressure rating. Fittings, ASTM D 2466 or ASTM D 2467. Pipe and fittings shall be of the same PVC plastic material and shall be one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: PVC 1120/PVC I; PVC 1220/PVC 12; PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing, ASTM D 2564. Pipe couplings, when used shall be tested as required by ASTM D 2464.

b. Polyvinyl Chloride (PVC) Plastic Piping with Elastomeric-Gasket Joints:

Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified.

c. Polyvinyl Chloride (PVC) Plastic Piping with Solvent Cement Joints:

Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

d. Polyethylene (PE) Plastic Pipe: Pipe tubing, and heat fusion fitting shall conform to AWWA C901.

2.2.1.4 Ductile-Iron Piping

Comply with "Ductile-Iron Piping" subparagraph under paragraph "Water Distribution Main Materials."

2.2.1.5 Insulating Joints

Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Curb or Service Stops

Ground key, round way, inverted key type; made of bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

2.2.2.3 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.2.4 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring, outside lever and weight type.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

2.2.2.5 Gate Valves 2 Inch Size and Larger on Buried Piping

Gate valves 2 inch size and larger on buried piping AWWA C500 or UL 262 and of one manufacturer. Valves, AWWA C500, nonrising stem type with double-disc gates. Valves, UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 175 psi. Materials for UL 262 valves conforming to the

reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair. Valves on _____ inch service lines shall have threaded ends. Valves on _____ inch service lines shall have ends suitable for joining to the pipe used; push-on joint ends or mechanical-joint ends for joining to ductile-iron pipe or push-on joint ends or mechanical-joint ends for joining to PVC plastic water main pipe; gaskets and pipe ends, AWWA C111/A21.11.

2.2.2.6 Gate Valves Smaller than 2 Inch in Size on Buried Piping

Gate valves smaller than 3 inch size on Buried Piping MSS SP-80, Class 150, solid wedge, nonrising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve. Provide handwheel operators.

2.2.2.7 Gate Valve 3 Inch Size and Larger

Gate valves 3 inch size and larger in valve chambers, valve pits, and aboveground locations, AWWA C500 or UL 262 and of one make. Valves conforming to: (1) AWWA C500 shall be outside-screw-and-yoke rising-stem type with flanged ends and double-disc, solid-wedge gates, except that valves _____ inch size shall have solid-wedge gates where indicated, and (2) UL 262 shall be outside-screw-and-yoke type, shall be designed for a hydraulic working pressure of 175 psi, and shall have flanged ends and double-disc or split-wedge, solid or one-piece, type gate, except that valves _____ inch size shall have solid or one-piece type gate where indicated. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Provide valves with handwheels that open by a counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair.

2.2.2.8 Gate Valves Smaller Than 2 Inch Size in Valve Pits

MSS SP-80, Class 150, solid wedge, inside screw, rising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve and a handwheel operator.

2.2.2.9 Curb Boxes

Provide a curb box for each curb or service stop. Curb boxes shall be of cast iron of a size suitable for the stop on which it is to be used. Provide a round head. Cast the word "WATER" on the lid. Each box shall have a heavy coat of bituminous paint.

2.2.2.10 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron, as indicated of a size suitable for the valve on which it is to be used and shall be adjustable. Precast concrete boxes installed in locations subjected to vehicular traffic shall be designed to withstand the following _____ AASHTO load designation as outline in AASHTO HB-17. Precast concrete boxes shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches as indicated. Cast-iron box shall have a heavy coat of bituminous paint.

2.2.2.11 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.2.2.12 Displacement Type Meters

Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in cubic meters U.S. gallon cubic feet. Meters in sizes 13 through 1/2 through 1 shall, shall not be frost-protection design. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C700.

2.2.2.13 Compound Type Meters

Compound type meters shall conform to AWWA C702 and shall, shall not be furnished with strainers. The main casing shall be bronze, cast iron protected by corrosion resistant coating with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be permanently sealed open and shall read in U.S. gallons, cubic feet. The meter shall, shall not be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C702.

2.2.2.14 Fire Service Type Meters

Fire service type meters shall be proportional type, turbine type conforming to AWWA C703 and shall, shall not be furnished with strainers. The main casing shall be bronze, cast iron protected by corrosion resistant coating with stainless steel external fasteners. Registers shall be straight-reading type, shall be permanently sealed, open and shall read in U.S. gallons, cubic feet. The meter shall, shall not be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C703. When turbine type main line meters are used, the meter shall be supplied with a separate check valve, as a unit.

2.2.2.15 Meter Boxes

Meter boxes shall be of cast iron, concrete, or plastic. Concrete meter boxes shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall use concrete covers with cast iron meter reader lids, shall be concrete with cast iron lid and cast iron meter reader lid. Plastic boxes and lids shall, shall not be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

2.2.2.16 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building, unless otherwise indicated. Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 10 feet from any sewer line. Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 10 feet on each side of the crossing, unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within 3 feet horizontally of the crossing. Lay water lines which cross sewer force mains and inverted siphons at least 2 feet above these sewer lines; when joints in the sewer line are closer than 3 feet horizontally from the water line, encase these joints in concrete. Do not lay water lines in the same trench with gas lines, fuel lines, or electric wiring. Copper tubing shall not be installed in the same trench with ferrous piping materials. Where nonferrous metallic pipe, e.g. copper tubing, cross any ferrous piping, provide a minimum vertical separation of 12 inches between pipes.

Where water piping is required to be installed within 1 m 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casting Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

Terminate the work covered by this section at a point approximately 5 feet from the building, unless otherwise indicated. Do not lay water lines in the same trench with gas lines, fuel lines, or electric wiring.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section _____.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position,

clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire (Metallic and Nonmetallic)

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped as indicated, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe.

3.1.1.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.1.7 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the setscrewed flange manufacturer. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer. Make grooved and shouldered type joints with the couplings previously specified for this type joint connecting pipe with the grooved or shouldered ends specified for this type joint; assemble in accordance with the recommendations of the coupling manufacturer. Groove pipe in the field only with approved groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings; secure approval for field-cut grooves before assembling the joint. Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves shall be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

b. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing), metal harness for pipe anchorage, except where metal harness is indicated. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Metal harness shall be in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as shown in NFPA 24, except as otherwise indicated.

d. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class A, Class C

polyethylene film, in accordance with AWWA C105/A21.5.

3.1.2.2 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

b. Offset: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing), metal harness for pipe anchorage, except where metal harness is indicated. Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength. Metal harness shall be as indicated.

d. Fittings: Install in accordance with AWWA C605.

3.1.2.3 Installation of Valves and Hydrants

a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation, except as otherwise indicated. Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

b. Installation of Hydrants: Install hydrants, except for metal harness, in accordance with AWWA C600 for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which hydrant is attached. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, contact the Contracting Officer for further instructions.

3.1.2.4 Installation Beneath Railroad Right-of-Way

Install piping passing under the right-of-way of a commercial railroad in accordance with the specifications for pipelines conveying nonflammable substances in Chapter 1, Part 5, of the AREMA Eng Man. For PVC plastic water main pipe, also install in accordance with the recommendations of AWWA M23 for installation of casings.

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at a point directed by the Contracting Officer, the points indicated; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines _____ inch size to the main by a corporation stop and gooseneck and install a service stop below the frostline, as indicated. Connect service lines 2 inch size to the main with a rigid connection or a corporation stop and gooseneck and install a gate valve on service line below the frostline, as indicated. Connect service lines _____ inch size to the main with a rigid connection and install a gate valve on service line below the frostline, as indicated. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps. Connect service lines to PVC plastic water mains in accordance with

UBPPA UNI-B-8 and the recommendations of AWWA M23, Chapter 9, "Service Connections." Connect service lines to concrete water mains in accordance with the recommendations of AWWA M9, Chapter 12, "Tapping Concrete Pressure Pipe." Connect service lines to steel water mains in accordance with the recommendations of the steel water main pipe manufacturer and with the recommendations for special and valve connections and other appurtenances in AWWA M11, Chapter 13, "Supplementary Design Data and Details."

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.4.2 Location of Meters

Meters and meter boxes, Vaults shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes, vaults to allow for reading and ease of removal or maintenance.

3.1.5 Disinfection

Prior to disinfection, obtain Contracting Officer approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Section _____. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water

mains and water service lines in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test PVC plastic water mains and water service lines made with PVC plastic water main pipe in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test concrete water mains in accordance with the recommendations in AWWA M9, Chapter 10, "Hydrostatic Testing and Disinfection of Mains." The amount of leakage on concrete pipelines shall not exceed 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline. Test steel water mains in accordance with applicable requirements of AWWA C600 for hydrostatic testing. The amount of leakage on steel pipelines with rubber-gasketed bell-and-spigot joints shall not exceed 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline; no leakage will be allowed at joints made by any other method. Repair of welded joints to stop leakage shall be done by welding only. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), plastic pipe joints, flanged joints, and screwed joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 33 20 00

WATER WELLS

04/08

PART 1 GENERAL

1.1 UNIT PRICES

Payment for each specified item will be made at the contract unit price for that item. Payment will include full compensation for equipment, materials and labor for drilling; removal and disposal of temporary casing, cuttings, and drill fluid; preparation of borehole logs; and sample handling, containers, storage, and testing. Depth, logging, installation, casing, riser pipe, and well screen shall be measured by linear distance. Payment will not be allowed for test holes or wells abandoned due to construction practices not in accordance with this specification, faulty construction practices or for the convenience of the Contractor.

1.1.1 Test Hole

Compensation for the test hole will be made at the contract unit price and will include material, equipment, and labor required to drill and perform tests on the test hole. Depth shall be measured as the total linear distance between ground surface and bottom of hole. If the total depth of hole is greater than that specified on the contract for "Test Hole," the additional depth will be paid for at the contract unit price for "Additional Test Hole Depth." If the test hole is developed into the permanent well with no increase in diameter, the Contractor will be compensated as described below, and separate payment will not be made for the test hole.

1.1.2 Water Well

Compensation for the water well will be made at the contract unit price and will include material, equipment, and labor required to drill, develop, perform tests, and complete the permanent well. Depth shall be measured as the total linear distance between ground surface and bottom of hole. If the total depth of well is greater than that specified in the contract for "Water Well," the additional depth will be paid for at the contract unit price for "Additional Water Well Depth."

1.1.3 Observation Well

Compensation for an observation well will be made at the contract unit price and will include material, equipment and labor required to drill, install, and complete the observation well, as well as perform tests and permanently grout it after use. Depth shall be measured as the total linear distance between ground surface and bottom of hole. If the total combined depth of observation wells is greater than that specified in the contract for "Observation Wells," the additional depth will be paid for at the contract unit price for "Additional Observation Well Depth."

1.1.4 Geophysical Logging

The "Geophysical Logging" unit price will include interpretation of the

logs and their delivery to the Government.

1.1.5 Well or Test Hole Decommissioning/Abandonment

Permanent decommissioning/abandonment of wells or test holes will be paid for only if it becomes necessary to abandon a well or test hole as specified, and only for work completed and accepted as specified. Payment will include compensation for drilling, casing removal, well sampling, materials, cement, mixing of cement, bentonite, and water, pumping of grout, equipment, removal of foreign objects, and transportation necessary to abandon the well or test hole and for the required well or test hole abandonment records.

1.1.6 Site Cleanup

Separate payment will not be made for cleanup of the site. Cleanup will mean restoring the site to its pre-construction condition, in accordance with paragraph SITE CLEANUP. Cleanup will be considered part of and incidental to the drilling, construction, and/or decommissioning of the well.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2005) Standard Methods for the Examination of Water and Wastewater
AWWA A100	(2006; Errata 2007) Water Wells
AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C200	(2005) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C206	(2003) Field Welding of Steel Water Pipe
AWWA C654	(2003) Disinfection of Wells

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 139/A 139M	(2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 312/A 312M	(2007) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM D 1586	(1999) Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1587	(2000e1; R 2007) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D 2216	(2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2239	(2003) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2487	(2006) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	(2006) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4750	(1987; R 2001) Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)
ASTM D 5079	(2002; R 2006) Preserving and Transporting Rock Core Samples
ASTM D 5088	(2002) Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D 5299	(1999; R 2005) Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities
ASTM D 5521	(2005) Development of Ground-Water Monitoring Wells in Granular Aquifers
ASTM D 5608	(2001; R 2006) Decontamination of Field Equipment Used at Low Level Radioactive Waste Sites

U.S. ARMY CORPS OF ENGINEERS (USACE)

CED TR GL-85-3	(1985) Geotechnical Descriptions of Rock and Rock Masses

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

1.3 SYSTEM DESCRIPTION

The well shall be located as shown, where directed, and be constructed in accordance with these specifications. Each well shall be installed to prevent aquifer contamination by the drilling operation and equipment, intra- and inter-aquifer contamination, and vertical seepage of surface water adjacent to the well into the subsurface, especially the well intake zone.

1.3.1 Notification

The Installation Environmental Coordinator (IEC) and the Contracting Officer shall be notified _____ days prior to drilling. The Contracting Officer, Contractor, Installation Environmental Coordinator (IEC) shall be responsible for contacting the State of _____, USEPA in accordance with the applicable reporting requirements. Before beginning work, the local United States Geological Survey office (USGS) and the State Environmental Protection office, State Geological Agency, state health department, local health department shall be notified of the type and location of wells to be constructed, the method of construction and anticipated schedule for construction of the wells.

1.3.2 Abandonment of Wells

If the Contractor fails to construct a well of the required capacity, or if the well is abandoned because of loss of tools, or for any other cause, abandon the hole as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Diagrams

As-built installation diagram for each well installed, prepared by the geologist present during well installation operations, within _____ working days of the completion of the well installation procedure.

SD-03 Product Data

Well Installation Plan

A plan as specified in paragraph WELL INSTALLATION PLAN describing the drilling methods, sampling, and well construction and well development 30 calendar days prior to beginning drilling operations. Mobilization activities may start prior to submittal of the plan. The plan shall be approved and signed by an

experienced geologist as specified in paragraph QUALIFICATIONS.

Well Material

Catalog data, and name of supplier, for well screens (to include the screen slot size), casing, riser pipe, filter pack material, bentonite, cement, centralizers, surface protective covers, well vaults, locking caps, airline oil filters for pneumatic drilling, dedicated sampling equipment, pumps, and chemical specifications on drill lubricants, tracers, disinfecting agents, and drill fluid additives, if used. Catalog data shall include any information, written or otherwise, supplied by the manufacturers or suppliers of the above listed items.

Qualifications

Personnel qualification documentation.

Site Conditions

A copy of all permits, licenses, or other legal requirements necessary for execution of the work shall be furnished _____ working days before commencement of the work.

Geophysical Logging

Five prints of the graphic boring log prepared to scale showing the required details, within _____ working days after completion of the test hole. This drawing shall be used for determining the well design, design of the filter pack, well screen location and screen openings.

SD-06 Test Reports

Survey Maps and Notes

Survey maps and notes, including a tabulated list of all wells and monuments, copies of all field books, maps showing the locations, and elevations of all wells, datum used (e.g. state plane NAD27, NAD83, UTM, etc.), elevation datum, units of measurement, and all computation sheets, within _____ working days after completion of the survey. Also, a diagram showing where on the top of the well the elevation was determined by the surveyor.

Well Development Records

A well development record, for each well, within _____ working days of the completion of development.

Geophysical Logs

Interpreted geophysical logs, within _____ working days of the completion of said logging.

Decommissioning/Abandonment Records

A well decommissioning record, for each well, or test hole abandoned, within _____ working days of the completion of the abandonment procedure.

Project Photographs

Before, during, and after completion of the work, take photographs of each well installation site. Photographs shall also be taken of any rock that is cored at the site.

Water Source

Decontamination and drilling water source analytical test results, within ____ working days before beginning drilling operations.

Filter Pack

Filter pack material test results; sieve and chemical analyses, within ____ working days after completion of the test hole.

Tests.

Test Reports within 24 hours following the conclusion of each test.

SD-07 Certificates

Casing

Cement and Bentonite Grout

Air line and gauge

Drilling mud

Well Screens

Water removed

Graveling equipment list

Construction of Filter Pack

1.5 QUALITY ASSURANCE

1.5.1 Well Installation Plan

Incorporate the following requirements into the Contractor's Well Installation Plan and follow them in the field. The plan shall include, but shall not be limited to, a discussion of the following:

a. Description of well drilling methods, and installation procedures, including any temporary casing used, placement of filter pack and seal materials, drill cuttings and fluids disposal, and soil/rock sample disposition.

b. Description of well construction materials, including well screen, riser pipe, centralizers, air line and gauge, tailpiece (if used), filter pack and filter pack gradation, bentonite or drilling mud, drilling fluid additives (if used), drilling water, cement, and well protective measures.

c. Description of quality control procedures to be used for placement of filter pack and seals in the boring, including depth measurements.

d. Forms to be used for written boring logs, installation diagrams of wells, geophysical logs, well development records, well sampling data records, state well registration forms, and well abandonment records.

e. Description of contamination prevention and well materials and equipment decontamination procedures.

f. Description of protective cover surface completion procedures, including any special design criteria/features relating to frost heave prevention. The maximum frost penetration for the site shall be included in this description.

g. Description of well development methods to be used.

h. List of applicable publications, including state and local regulations and standards.

i. List of personnel assignments for this project, and personnel qualifications.

j. Description of well decommissioning/abandonment procedures.

k. Description of well capacity testing techniques.

l. Description and discussion of geophysical techniques to be employed at the site.

m. Description of permanent pump to be installed, and discussion of pump operating tests to be employed at the site.

n. Description of specific methods to be employed to control potential contamination or pollution arising from well installation activities.

1.5.2 Qualifications

A geologist with at least 3 years experience in hazardous waste projects, soil and rock logging, and well installation, registered in the state of ____, shall be on site and responsible for all geophysical and borehole logging, drilling, well installation, developing and testing activities. The driller shall be licensed in the state of _____, according to the state requirements. Geophysical log interpretation shall be done by a qualified log analyst. The log analyst shall be able to demonstrate competence through background, training, and experience when so called upon. The Contractor shall have a minimum of _____ years of well installation experience. The Contractor's staff shall include appropriate health and safety personnel as specified in Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES, and personnel qualified to perform the necessary chemical sampling as presented in the approved Sampling and Analysis Plan, prepared as specified in Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL.

1.5.3 Test Holes

Before starting construction of the well, a test hole of at least 4 inches in diameter shall be drilled at the location of the well into the target

water bearing stratum, strata as directed by the Contracting Officer. Test holes should be drilled in a manner to protect the subsurface from surface contamination. Test holes should be carefully advanced and sampled to determine the presence of the upper aquiclude if one exists. The boring should then be properly cased, grouted, and sealed into the aquiclude before the boring is advanced through the aquiclude into the aquifer. The test hole shall be used to determine the expected yield from the well, water quality, optimum depth, and to log the strata encountered. Before conducting a capacity test, the well shall be cased, and screened in accordance with these specifications. Test holes shall be logged in accordance with paragraph BOREHOLE LOGS. A temporary casing may, shall be used. If used, the temporary casing shall be seated into the top of the rock, at the top of the stratum being tested. The test hole may be converted to the permanent well, in accordance with these specifications. If the test hole is not used for the permanent well, the test hole shall be abandoned as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT.

1.5.4 Sampling

1.5.4.1 Sampling for Chemical Analysis

Sampling requirements for obtaining and preserving samples for chemical analysis shall be included in the Sampling and Analysis Plan as required in Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL.

1.5.4.2 Sampling for Geotechnical Analysis

Samples shall be taken of all materials penetrated by each drilled well/test hole. Soil sampling shall be done with a split, thin-walled, tube sampler using standard sampling techniques in accordance with ASTM D 1586, ASTM D 1587. Samples shall be extracted from their in-situ environment in as near an intact, minimally disturbed condition as technically practical. Samples shall be obtained continuously through the area expected to be screened. Provide sieve analyses of all drive-sampled material. Sieve analyses shall be conducted in accordance with ASTM C 136. The gradation of the natural formation shall be determined through the use of sieve analyses performed on formation samples taken from the areas to be screened. Drive-sampled materials shall be placed in airtight containers and labeled as specified in paragraph SAMPLE CONTAINERS. Samples shall be delivered to the Contracting Officer designated facility. Representative soil samples s hall be tested for grain-size distribution by mechanical means (sieves down to the No. 200 size according to ASTM C 136), moisture content according to ASTM D 2216 and Atterberg limits according to ASTM D 4318. Description and identification of soils shall be done in accordance with ASTM D 2488. Laboratory classification of soils shall be done in accordance with ASTM D 2487. Sampling shall be performed to allow completion of the documents described in paragraph BOREHOLE LOGS.

1.5.5 Observation Wells

After completion of the test hole, pump well, 1 observation well(s), or more as directed, at least 1-3/4 inches in diameter shall be drilled to the target water bearing stratum, at the location(s) indicated on the drawings, at a location _____ feet from, at an appropriate location near, the test hole, pump well. The observation well shall be used in conjunction with the yield test of the test hole and capacity test of the pump well. After final acceptance of the pump well by the Contracting Officer, the observation well shall be abandoned as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT, left in place for future monitoring of the

well system.

1.5.6 Geophysical Logging

The total depth of each test hole drilled shall be geophysically logged. Geophysical logging shall be documented in accordance with paragraph Geophysical Logs. Run one successful natural gamma ray or gamma-gamma for the full depth, (top to bottom of test hole); one successful neutron in the fluid filled portion of the hole, (top to bottom of test hole); one successful (top to bottom of test hole) spontaneous potential (self-potential); and, one successful (top to bottom of test hole) resistivity log, for each test hole. Log analyses and interpretations shall be made by a person qualified in accordance with paragraph QUALIFICATIONS.

1.6 DELIVERY, STORAGE, AND HANDLING

Store and maintain well materials in a clean, uncontaminated condition throughout the course of the project. Filter pack material shall not be allowed to freeze before installation.

1.7 SITE CONDITIONS

Access to each well site, including any utility clearance, permits, licenses, or other requirements and the payment thereof necessary for execution of the work, is the responsibility of the Contractor, Government. Obtaining rights-of-entry is the responsibility of the Contractor, Government. Visit each proposed well location to observe any condition that may hamper transporting equipment or personnel to the site. If clearing, or relocation is necessary, the Contractor, Installation Environmental Coordinator, and the Contracting Officer shall agree on a suitable clearing, or relocation plan, and the location of any required access road.

PART 2 PRODUCTS

2.1 CASING

All casing, screen, and other well material shall be of compatible materials to prevent galvanic reaction between components of the completed well.

2.1.1 Steel Casing and Couplings

Steel casing shall be new carbon steel, conforming to ASTM A 139/A 139M Grade B, standard weight galvanized, black, steel pipe, conforming to ASTM A 53/A 53M, steel pipe conforming to AWWA C200 type 304 or type 316 stainless steel and shall be nominal _____ inch diameter, _____ inch wall thickness schedule 5S meeting the requirements of ASTM A 312/A 312M, as applicable. Joints shall be either threaded and coupled, or field welded in accordance with AWWA C206. Casings shall be provided with drive shoes.

2.2 WELL SCREENS

Well Screens shall be a minimum of 4 inches nominal diameter, and shall be directly connected to the bottom of the inner casing by an approved method. The length of the screen shall be sufficient to provide an intake area capable of passing not less than the minimum required yield of the well, at an entrance velocity not exceeding 0.1 fps. The opening, or slot

size of the screen, shall be _____ inch determined by the Contractor designed based on analysis of the distribution of the grain size of the aquifer materials encountered during drilling, artificial filter pack, be compatible with the material surrounding the screen, and shall be submitted for approval as part of the well installation plan. The well screen shall be of sufficient size and design to hold back and support the gravel used in the filter pack envelope and in-situ material surrounding the screen. The screen and all accessories required for satisfactory operation shall be essentially standard products of manufacturers regularly engaged in the production of such equipment. Field constructed screen is not acceptable. "Blanks" in the well screen may be utilized in nonproductive zones, or where centering devices are needed in the screened area, and shall be considered "casing." The bottom section, below the screen, shall be sealed watertight by means of a flush threaded, welded end cap of the same material as the well screen.

2.2.1 Metal Screen

Metal screen shall be of an approved wire-wound type and shall be type 304 or type 316 stainless steel, conforming to the applicable requirements of AWWA A100. A wire-wound screen manufactured with supporting bars or core of material different from the wire will not be acceptable. Joints shall be made of threaded couplings of the same material as the screens or by brazing or welding in accordance with AWWA C206.

2.3 FILTER PACK

Filter pack material shall be a product of a commercial sand and gravel supplier, shall be properly sized and graded for the surrounding soil encountered, and shall be composed of clean, round, hard, waterworn siliceous material, free of flat or elongated pieces, organic matter, or other foreign matter. The filter material shall be of a size which will allow the maximum flow of water into the well and prevent the infiltration of sand and silt. The gradation of the filter material shall be such that the uniformity coefficient is not more than 2.5. The filter material shall be thoroughly sterilized with chlorine or hypochlorite immediately before being placed, placed as directed.

2.4 BENTONITE SEAL

The bentonite seal, intended to keep grout from entering the filter pack, shall consist of hydrated granular, or pelletized, sodium montmorillonite furnished in sacks or buckets from a commercial source and shall be free of impurities which adversely impact the water quality. If the bentonite seal is located above any borehole fluid levels, a layer of fine sand shall be placed at the top of the bentonite seal, to provide an additional barrier to any downward migration of grout.

2.5 CEMENT AND BENTONITE GROUT

2.5.1 Cement Grout

Cement grout shall consist of Portland cement conforming to ASTM C 150, Type I or II, sand and water. Cement grout shall be proportioned not to exceed 2 parts, by weight, of sand to 1 part of cement with not more than 6 gallons of water per 94 lb bag of Portland cement, with a mixture of such consistency that the well can be properly grouted. No more than 5 percent by weight of bentonite powder may be added to reduce shrinkage.

2.5.2 Bentonite Grout

High-solids bentonite grout shall be made from sodium bentonite powder and/or granules. Water from an approved source shall be mixed with these powders or granules to form a thick bentonite slurry. The slurry shall consist of a mixture of bentonite and the manufacturer's recommended volume of water to achieve an optimal seal. The slurry shall contain at least 20 percent solids by weight and have a density of 9.4 lb/gallon of water or greater.

2.6 PERMANENT PUMP

Permanent pump shall be an approved submersible jet or _____ type with a capacity sufficient to deliver _____ gpm. The pump shall be connected to the pump controls by a three-wire drop line. Piping for the well drop line shall be polyethylene plastic pipe conforming to ASTM D 2239, galvanized steel pipe conforming to ASTM A 53/A 53M. The pump shall operate on 208 volts, 60 Hz, 3 single-phase power, and the motor shall be of sufficient size to operate the pump under the maximum operating conditions without exceeding its rating. Pump shall be equipped with necessary controls to provide for automatic operation of the pump. The pump and motor unit shall be no larger than _____ inches in diameter at any point.

2.7 CONTAINERIZATION OF DEVELOPMENT WATER, AND DRILL CUTTINGS

Water removed during development and testing operations, and cuttings from the drilling operations shall be contained in D.O.T.-approved drums, containers, or vessels as specified in 49 CFR 172. Furnish polyethylene and steel drums with lids, lid gaskets, bolts, chain of custody forms and drum labels. Mark each drum label in accordance with 49 CFR 172 in addition to the following information: drum number, site name, well name and number, contents and date, approximate depth of material contained in each drum and the name and phone number of the Installation Environmental Coordinator (IEC), Contracting Officer.

2.8 SAMPLE CONTAINERS

Drill cuttings and driven samples for geotechnical purposes shall be placed in air-tight pint size plastic, glass containers and labeled with the project name, date of sample, well number and depth at which the sample was taken. Both the container and lid shall be labeled in permanent indelible ink. Jars shall be placed in partitioned cardboard boxes. Boxes shall be labeled with project number and well number. Containers and boxes shall be furnished by the Contractor. Core samples shall be preserved and prepared for transport as described in ASTM D 5079. Cored rock samples shall be placed in wooden core boxes as indicated on the drawings. Spacers shall be placed in the proper positions in the core boxes to show the location and actual extent of voids and core losses as clearly as possible. The spacers shall be made of wood, or some other relatively light material which is of sufficient strength to withstand jarring and crushing in handling. Spacers shall be of a strongly contrasting color pattern so that core losses will be accented either by direct observation or in photographs. In the smaller sizes, up to and including 6 inches, the spacers shall be the same width as the cores. The outside and the inside of the core box lid shall be labeled with the project name, hole number, date sampled, location, surface elevation, core box number, and interval of depth of core. The information on the label shall be such that it can clearly be read in photographs of the core box. Both ends of the core box shall also be labeled with the hole number and box number. The core shall be placed in the core box

starting at the left hand corner on the hinge side and running to the right. Successive cores down the hole shall be placed in successive troughs, starting from the back and working toward the front of the box so that the core can be read in the same manner as a printed page, from left to right, when standing in front of the open box.

PART 3 EXECUTION

3.1 PROTECTION OF EXISTING CONDITIONS

Maintain existing survey monuments and wells, and protect them from damage from equipment and vehicular traffic. Any items damaged by the Contractor shall be repaired by the Contractor. Wells requiring replacement due to Contractor negligence shall be re-installed according to these specifications. Wells scheduled for abandonment shall be protected from damage so that abandonment may be performed according to these specifications. Prior to excavation, obtain written approval from the local utility companies to drill at each site, to avoid disturbing buried utilities.

3.2 PREPARATION

3.2.1 Decontamination

The drill rig, drill rods, drill bits, augers, temporary casing, well developing equipment, tremie pipes, grout pumping lines, and other associated equipment shall be cleaned with high-pressure hot water/steam prior to drilling at each well location. Decontamination shall be done in accordance with ASTM D 5088 or ASTM D 5608. Decontamination shall be performed at a central decontamination station. Cleaning shall be performed in an area that is remote from, and cross- or down-gradient from the well being drilled. Screen and well casing shall be cleaned with high-pressure hot water immediately prior to installation in the well. The use of factory sealed (plastic wrapped) screen and well casing does not waive this requirement for pre-installation cleaning. Samplers shall be decontaminated in accordance with the Sampling and Analysis Plan as required in Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL. The water used for cleaning shall be from a Government approved source. The water source used for cleaning shall be sampled and tested for the constituents specified in the Sampling and Analysis Plan prior to use at the site.

3.2.2 Decontamination Station

Construct a temporary decontamination pad onsite. The pad shall be bermed and slightly inclined towards a sump located in one of the back corners of the pad. Plastic sheeting shall line the pads and berms to contain decontamination water. Plywood sheeting, exterior grade, shall be placed over the plastic sheeting to prevent damage to the plastic and allow the drill rig and heavy equipment to use the pad. The minimum dimensions of the pad shall be the length and width of the drill rig, plus 4 feet per side to allow access and steam cleaning. Yellow ribbon shall be used to encircle the decontamination pad. Water collected in the sump shall be pumped using a "trash" pump to transfer water to a 55 gallon drum labeled "Decontamination Pad Sump Water." Solid waste shall be transferred to a separate 55 gallon drum labeled "Decontamination Pad Sump Sludge."

3.2.3 Water Source

If well drilling/installation requires the use of water, prior to its use at the site, the water source shall be sampled and tested, and approved by the Contracting Officer for the constituents specified in the Sampling and Analysis Plan as required in Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL. The Contractor is responsible for locating the source, obtaining the water from the source, transporting it to, and storing it at the site. A water sample shall be obtained from the container used in transporting the water to the site before the water is used for decontamination. This sample shall be tested and approved in accordance with the above requirements.

3.3 WELL CONSTRUCTION

The drilling method shall be as approved by the Contracting Officer and shall conform to all state and local standards for water well construction. The execution of the work shall be by competent workmen and shall be performed under the direct supervision of an experienced well driller. The drilling method shall prevent the collapse of formation material against the well screen and casing during installation of the well. The inside diameter of any temporary casing used shall be sufficient to allow accurate placement of the screen, riser, centralizer(s), filter pack, seal and grout. Any drilling fluid additive used shall be inorganic in nature, but be phosphate free. Grease or oil on drill rods, casing, or auger joints are not permitted; however, PTFE tape or vegetable oil (in solid phase form) are acceptable. The drill rig shall be free from leaks of fuel, hydraulic fluid, and oil which may contaminate the borehole, ground surface or drill tools. Casing pipe, well screens, and joint couplings shall be of compatible materials throughout each well. The well shall be a filter pack well, naturally developed well activated in the overburden, water-bearing stratum, stratum based on test hole data. The well shall be drilled straight, plumb, and circular from top to bottom. The well shall be initially drilled from the ground surface to the uppermost level of the water bearing strata, top of rock and the bottom of the outer casing set at this elevation. The hole below the outer casing shall penetrate the water bearing stratum a sufficient depth to produce the required amount of water without causing excessive velocities through the aquifer. During construction of the wells, precautions shall be used to prevent tampering with the well or entrance of foreign material. Runoff shall be prevented from entering the well during construction. If there is an interruption in work, such as overnight shutdown or inclement weather, the well opening shall be closed with a watertight uncontaminated cover. The cover shall be secured in place or weighted down so that it cannot be removed except with the aid of the drilling equipment or through the use of drill tools.

3.3.1 Setting Outer Casing

The outer casing shall not be less than 8 inches in diameter. The hole shall be of sufficient size to leave a concentric annular space of not less than 2-1/2 inches and not more than 6 inches between the outside of the outer casing and the walls of the hole. The annular space between the outer casing and the walls of the holes shall be filled with cement grout. Acceptable methods of grouting are detailed in AWWA A100; the approved method shall specify the forcing of grout from the bottom of the space to be grouted towards the surface. A suitable grout retainer, packer, or plug shall be provided at the bottom of the inner casing so that grout will not leak into the bottom of the well. Grouting shall be done continuously to

ensure that the entire annular space is filled in one operation. After grouting is completed, drilling operations shall not be resumed for at least 72 hours to allow proper setting of the grout.

3.3.2 Temporary Casing

Temporary well casing of either iron or steel of sufficient length to case to the bottom of all borings shall be available at the construction site. The Contracting Officer will direct the use of a temporary casing to the bottom of the boring during drilling and placement of screen, riser, and filter pack when he believes it is necessary to provide adequate support to the sides of the hole. When the walls of the boring will require support only during development operations a temporary casing will be required to extend only to a depth 3 feet below the top of the filter pack. The temporary casing, shall have an inside diameter of not less than _____ inches, shall have sufficient thickness to retain its shape and maintain a true section throughout its depth, and may be in sections of any convenient length. The temporary casing shall be such as to permit its removal without disturbing the filter pack, riser, or well screen. The setting of temporary casing shall be such that no cavity will be created outside of it at any point along its length. In the event the temporary casing should become unduly distorted or bent it should be discarded and a new casing should be used during installation of any additional well.

3.3.3 Construction of Inner Casing and Screen

After the grout has set, the hole below the outer casing shall be reamed at the required diameter, to the required depth, by an approved method which will prevent caving of the hole before or during installation of the filter pack, well screen and inner casing. In lieu of reaming, the entire well may be drilled to the diameter of the filter pack with an annular space between the inner casing and outer casing equal to the thickness of the filter pack. The outer casing shall be increased in size to provide for this space, if this option is elected. The well screen and inner casing shall be firmly attached, and lowered into the hole by a method which will allow for control of the rate of fall of the well screen and inner casing at all times. Well screen and inner casing shall not be dropped or allowed to fall uncontrolled into the hole. The inner casing shall extend up through the outer casing to _____ feet above, below the ground surface. Approved centering devices shall be installed at a spacing of 120 degrees, between the outer casing and inner casing prior to well construction at intervals not exceeding 25 feet along the length the top of the inner casing and the bottom of the outer casing. If the screen length is greater than 25 feet, a 3 foot length of blank casing shall be placed in the middle of the screen interval for placement of centering devices. Centering devices shall not be placed on the screened interval, or within the bentonite seal, if used.

3.3.4 Construction of Filter Pack

After the screen and inner casing have been concentrically set in the hole below the outer casing, the approved filter pack shall be constructed around the screen by filling the entire space between the screen and the wall of the hole in the water bearing stratum with filter pack material. A tremie pipe having an inside nominal diameter of not less than 1-1/2 inches shall be lowered to the bottom of the well between the hole and screen. The tremie pipe shall be arranged and connected, at the surface of the ground, to water pumping and graveling equipment so that water and filter material, fed at uniform rates, are discharged as the filter material fills

the hole from the bottom up. The tremie pipe shall be raised at a rate that will keep the bottom of the pipe no more than 3 feet above the filter material level at all times. If the Contractor desires to use methods of placing filter material other than those specified, the details of the method and equipment proposed shall be submitted to the Contracting Officer, before filter pack placement is begun; however, dumping filter pack material from the surface of the ground and agitating the well in an effort to settle the filter will not be allowed. The filter pack shall be installed continuously and without interruption until the filter pack has been placed to within 1 foot of the top of the inner casing 5 feet of the ground surface 30 feet above the top of the screen. The depth to the top of the filter pack shall be directly measured, and recorded. Any water added to the filter pack material shall be obtained in accordance with paragraph Water Source. Filter pack material shall be protected from contamination prior to placement by either storing it in plastic lined bags, or in a location protected from the weather and contamination on plastic sheeting. Filter pack material shall not be allowed to freeze before installation. Filter pack material shall be transported to the well site in a manner which prevents contamination by other soils, oils, grease, and other chemicals. Temporary drill casing, if installed, or hollow stem auger, shall be removed simultaneously with the above operation. Filter pack material shall be placed in no greater than 3 foot lifts prior to retraction of the temporary casing/auger. A minimum of 6 inches of filter pack shall remain in the temporary casing/auger at all times during filter pack installation. Frequent measurements shall be made inside the annulus during retraction to ensure that the filter pack is properly placed.

3.3.5 Bentonite Seal

After the inner casing and well screen and filter pack have been installed,and after predevelopment of the well, the annular space between the inner and outer casings shall be sealed by use of a bentonite seal. A minimum 3 foot thick hydrated bentonite seal shall be placed on top of the filter pack in a manner which prevents bridging of the bentonite in the annulus. The bottom of the bentonite seal shall be a minimum of 5 feet above the top of the well screen. The depth to the top of the bentonite seal shall be directly measured, and recorded immediately after placement, without allowance for swelling. If the bentonite seal is located above any borehole fluid levels, a 1 foot layer of fine sand shall be placed at the top of the bentonite seal.

3.3.6 Grout Placement

After the inner casing and well screen, filter pack have been installed, a non-shrinking cement, high-solids bentonite grout, shall be mechanically mixed in accordance with paragraph CEMENT AND BENTONITE GROUT, and placed by tremie pipe, in one continuous operation into the annulus between the inner and outer casings above the bentonite seal to within ____ feet of the ground surface, the maximum depth of frost penetration (frost line). Grout injection shall be in accordance with AWWA A100. If the casing interval to be grouted is less than 15 feet, and without fluids after any drill casing is removed, the grout may be placed either by pouring or pumping. The tremie pipe shall be thoroughly cleaned with high pressure hot water/steam before use in each well. The bottom of the tremie pipe shall be constructed to direct the discharge to the sides rather than downward. The discharge end of the tremie pipe shall be submerged at all times. Additional grout shall be added from the surface to maintain the level of the grout within _____ feet of the ground surface at the land surface as settlement occurs. Work shall not be conducted in the well within 24 hours

after cement grouting. The alignment of the well shall be verified by passing a 5 foot long section of rigid PVC, stainless steel, PTFE pipe 1/4 inch smaller in diameter than the inside diameter of the casing through the entire well. If the pipe does not pass freely, the well will not be accepted. The pipe section shall be thoroughly cleaned with high pressure hot water/steam prior to each test.

3.4 WELL DEVELOPMENT

Within 7 days of completion of each well, but no sooner than 48 hours after cement grouting is completed, the well shall be developed. Predevelopment, or development after the filter pack has been installed, but before the annular seal is installed, may be initiated before this minimum 48 hour period. The well shall be developed in accordance with the Well Installation Plan, by approved methods until the water pumped from the well is substantially free from sand, and until the turbidity is less than 5 on the Jackson Turbidity Scale specified in AWWA 10084. Developing equipment shall be of an approved type and of sufficient capacity to remove all cutting fluids, sand, rock cuttings, and any other foreign material. The well shall be thoroughly cleaned from top to bottom before beginning the well tests. Development shall be performed using only mechanical surging, over pumping, or jetting, or a combination thereof per ASTM D 5521. Details of the proposed development method shall be included in the Well Installation Plan. At the time of development of any well, the well shall be free of drawdown or surcharge effects due to pump testing, developing or drilling at another location. The Contractor is responsible for maintaining at the well site the needed access and work area and clearance, necessary to accomplish development. Furnish, install, or construct the necessary discharge line and troughs to conduct and dispose of the discharge a sufficient distance from the work areas to prevent damage, as directed in paragraph CONTAINERIZATION OF DEVELOPMENT WATER, AND DRILL CUTTINGS. Development shall be conducted to achieve a stable well of maximum efficiency and shall be continued until a satisfactory sand test, as specified in paragraph Sand Test, is obtained. During predevelopment of the well, filter pack material shall be added to the annular space around the screen to maintain the top elevation of the filter pack to the specified elevation. Provide an open tube or other approved means for accurately determining the water level in the well under all conditions. If, at any time during the development process it becomes apparent in the opinion of the Contracting Officer that the well may be damaged, development operations shall be immediately terminated. The Contracting Officer may require a change in method if the method selected does not accomplish the desired results. The Contracting Officer may order that wells which continue to produce excessive amounts of fines after development for 6 hours be abandoned, plugged, and backfilled, and may require the Contractor to construct new wells nearby. All materials pulled into the well by the development process shall be removed prior to performing the pumping test.

3.4.1 Jetting

Jetting should be performed using either a single or double ring jet. If a double ring jet is used the rings should be 2 feet apart. The jetting tool shall be constructed of high-strength material and conservatively designed and proportioned so that it will withstand high pressures. The jetting tool shall have two 3/16, 1/4, 3/8 inch diameter hydraulically balanced nozzles spaced 180 degrees four 3/16, 1/4, 3/8 inch diameter holes spaced 90 degrees apart and which shall exert the jetting force horizontally through the screen slots. The rings shall be constructed such that the

tips of the jets shall be within 1/2 inch from the inner surface of the well screen. The pump used in conjunction with the jetting tool shall be capable of providing pressures up to 250 psi. a minimum jetting fluid exit velocity of 150 f/s. Prior to commencing jetting, and following each jetting cycle, all sand and/or other materials shall be removed from inside the screen. The jetting process shall start at the bottom of the screen and consist of rotating the jetting tool slowly, 1 cycle per 30 seconds cycles per seconds while rotating the pipe 180, 90 degrees for two minutes at each location then raising the pipe 6 inches. All wells, more than 4 inches in diameter, shall be pumped during the jetting cycle to remove incoming sand and other material. Such pumping shall be at a rate not less than 115 percent of the rate at which fluid is introduced through the jetting tool. This will allow a flow of material into the well as it is being developed. Water used for development shall be free of sand. The contracting officer may require other means of developing the well such as intermittent pumping method, variation of the intermittent pumping method, or surge block if it appears that the development of the well is not producing the desired results.

3.4.2 Intermittent Pumping

Intermittent pumping shall be performed by pumping the well at a capacity sufficient to produce a rapid drawdown of approximately _____ feet stopping the pump (backflow through pump will not be permitted) to permit the water surface to rise to its former elevation, and repeating this procedure. Cycle time for this procedure will vary as directed but will not be more than 3 cycles per minute. A pump discharge in excess of _____ gpm will be required. A deep well turbine pump, or electric submersible pump with check valve, shall be used with any attachment necessary to accomplish rapid starting and stopping for intermittent pumping. The intake shall be set at least 10 feet below the maximum expected drawdown in the well. Prior to commencing intermittent pumping, and periodically during development by this method, all sand and/or other materials shall be removed from inside the screen. The amount of drawdown may be decreased if, in the opinion of the Contracting Officer, the efficiency of the well might otherwise be impaired.

3.4.3 Surging

Surging of the well shall require use of a circular block, or multiple blocks, which are approximately 1 inch smaller in diameter than the inside diameter of the well and is constructed of a material which will not damage the screen if the block comes in contact with the screen, and a bailer or pump to remove materials drawn into the well. The surging shall be continued for a period of approximately one hour, or until little or no additional material from the foundation or filter pack can be pulled through the screen. The surge block shall be moved by a steady motion up and down the full length of the well screen. Prior to commencing surging, and periodically during development by this method, all sand and/or other materials shall be removed from inside the screen. All materials pulled into the well by the surging process shall be removed by the Contractor.

3.4.4 Well Development Criteria

A well development record shall be maintained in accordance with paragraph Well Development Records. Development is complete when all of the following criteria are met:

a. Well water is clear to the unaided eye ,and turbidity less than or

equal to 5 Nephelometric Turbidity Units (NTUs),

b. Sediment thickness in the well is less than 1 percent of the screen length, 0.1 foot,

c. A minimum of three times the standing water volume in the well is removed plus three times the volume of all added water and drilling fluid lost during drilling and installation of the well is removed, and

d. Temperature, specific conductivity, pH,oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity readings, measured before, twice during and after development operations, have stabilized. Stabilization shall mean variation of less than 0.2 pH units, variation of plus or minus ± 1 degree F,± 3 percent change in specific conductance; and less than a ± 10mV for ORP; and ± 10 percent for DO, and turbidity, measured between three consecutive readings with one casing volume of water removed between each reading. ORP shall be determined in accordance with AWWA 10084. Temperature, specific conductance, DO, turbidity, and pH readings shall be conducted in accordance with EPA 600/4-79/020. At completion of well development, approximately 1 pint of well water shall be collected in a clear glass jar. The jar shall be labeled with project name, well number and date; and photographed using 35 mm color print film. The photograph (minimally 5 x 7 inch) shall be a suitably backlit close-up which shows the clarity of the water and any suspended sediment. The photograph and negative shall become a part of the well development record. Water removed during development and testing operations shall be contained in D.O.T. approved drums, containers or vessels and disposed of by, in accordance with paragraphs CONTAINERIZATION OF DEVELOPMENT WATER, AND DRILL CUTTINGS, and Drilling Waste Disposal, discharged to the ground surface at least _____ feet from the well in a down gradient area.

3.5 TESTS

After the wells have been developed, notify the Government and make the necessary arrangements for conducting the capacity tests. If the capacity test indicates that the required capacity can be obtained, the tests for quality of water shall be made. If the capacity and quality tests indicate that the required capacity and quality can be obtained, the permanent well, as specified, shall be completed at that depth. Prior to making quality tests, drilling equipment, tools and pumps contacting well water shall be cleaned with live steam.

3.5.1 Capacity Test

Furnish and install an approved temporary test pump, with discharge piping of sufficient size and length to conduct the water being pumped to point of discharge, and equipment necessary for measuring the rate of flow and water level in the well. An 8 hour constant-rate, step-drawdown, capacity test shall be run with the pumping rate and drawdown at the pump well and observation wells recorded every 30 minutes, 1/2 minute during the first 5 minutes after starting the pump; then every 5 minutes for an hour; then every 20 minutes for 2 hours. From this point on, readings taken at hourly intervals, until the water level stabilizes, shall be sufficient. Observation wells (piezometers) shall be read on the same schedule as the pump well. During the step-drawdown test, the pumping rate shall be increased in steps at regular, 2 hour intervals. Specific capacity shall be measured for each step. The test shall begin at the rate of the expected capacity of well ____ gpm and at least that rate maintained

throughout the duration of the test, step interval. The well shall be "step" tested at rates of approximately 1/2, 3/4, 1 and 1 1/2 times the design capacity of _____ gpm. If this capacity cannot be maintained for the test period, the capacity test shall be terminated and the test hole drilled deeper or relocated as directed. When the pump is shut off, water level readings shall be taken during the rebound period for the same intervals of time as the drawdown test. The record of the test, in triplicate, shall be delivered to the Contracting Officer.

3.5.2 Test for Plumbness and Alignment

Upon completion of the permanent well, plumbness and alignment shall be tested by lowering into the well, to the total depth of the well, a plumb 40 feet long or a dummy of the same length. The outer diameter of the plumb shall not be more than 1/2 inch smaller than the diameter of that part of the hole being tested. If a dummy is used, it shall consist of a rigid spindle with three rings, each ring being 12 inches wide. The rings shall be cylindrical and shall be spaced one at each end of the dummy and one in the center. The central member of the dummy shall be rigid so that it will maintain the alignment of the axis of the rings. The dummy shall be decontaminated as specified in paragraph Decontamination, before use. If the plumb or dummy fail to move freely throughout the length of the casing or well screen for the depth of well or should the well vary from the vertical in excess of two-thirds the inside diameter of that part of the well being tested for each 100 feet of depth, the plumbness and alignment of the well shall be corrected. If the faulty alignment and plumbness is not correctable, as determined by the Contracting Officer, the well shall be abandoned as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT and a new well drilled at no additional cost to the Government.

3.5.3 Test for Quality of Water

When the capacity test in the test hole has been completed, and again after the yield in the permanent well and drawdown test or capacity test have been completed, secure samples of the water in suitable containers, and of sufficient quantity, to have bacterial, physical, and chemical analyses made by a recognized testing laboratory, except that the bacterial analysis may be made by the applicable State Board of Health, if desired. Water Quality Analysis shall address each item specified in the Water Quality Analysis Table at the end of this section. Expenses incident to these analyses shall be borne by the Contractor and the results of the analyses shall be furnished to the Contracting Officer. All sampling and analyses shall be performed using EPA and State approved methods, procedures, and holding times.

3.5.4 Sand Test

As part of each capacity test, or at the end of each intermittent pumping, a determination of the amount of sand (filter pack and/or foundation material) a well is producing shall be performed. Prior to starting the sand test all material shall be removed from the bottom of the tailpipe. Test each well by pumping at a rate of gpm, sufficient to produce approximately _____ feet of draw-down. After the pump is at the desired pumping rate the flow from the discharge shall be diverted into a container that will collect all the sand being carried by the water through a Rossum Sand Tester. Development of the well is satisfactory if the amount of sand

collected is less than 1 pint per 25,000 gallons of water pumped at the specified rate. Upon completion of the test the amount of sand in the tailpipe shall be determined to verify that no material is being deposited in the bottom of the well.

3.6 INSTALLATION OF PERMANENT PUMP

The permanent well pump shall be installed in the well at a minimum depth of 25 feet below the maximum drawdown groundwater level after the drawdown test has been completed. The pump shall be secured at the required elevation as recommended by the pump manufacturer. After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Tests shall assure that the pumping units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly.

3.7 DISINFECTING

After completion of tests of well, or installation of permanent pump, or at time of tests for yield and drawdown test, whichever is later, the wells shall be disinfected by adding chlorine, conforming to AWWA B301, or hypochlorite, conforming to AWWA B300, in sufficient quantity so that a concentration of at least 50 ppm of chlorine shall be obtained in all parts of the well. Chlorine solution shall be prepared and introduced into the well in an approved manner and shall remain in the well for period of at least 12 hours but not more than 24 hours. Information on methods for preparing chlorine solution and introducing it into the well may be found in AWWA C654. After the contact period, the well shall be pumped until the residual chlorine content is not greater than 1.0 ppm. The well shall be pumped to waste for an additional 15 minutes with less than 1 ppm chlorine residual after which two samples shall be taken not less than 30 minutes apart and tested for the presence of coliform bacteria. The well shall be disinfected and redisinfected as may be required until two consecutive samples of water are found upon test to be free from Coli Acrogenes group of organisms.

3.8 PUMPHOUSE AND SLAB

Pumphouse and slab shall be constructed preventing the infiltration of surface water or precipitation into the well. The slab shall be 4 feet square by 6 inches thick and constructed of reinforced concrete. The top of the outer casing shall extend 12 inches above the top of the slab. The top of the slab shall be at elevation _____ or higher. The pumphouse shall be constructed on the slab and thermally insulated.

3.9 SITE CLEAN-UP

After completion of the work, tools, appliances, surplus materials, temporary drainage, rubbish, and debris incidental to work shall be removed. Excavation and vehicular ruts shall be backfilled and dressed to conform with the existing landscape. Utilities, structures, roads, fences, or any other pre-existing item which must be repaired or replaced due to the Contractor's negligence shall be the Contractor's responsibility; repair or replacement shall be accomplished prior to completion of this contract.

3.10 DRILLING WASTE DISPOSAL

Slurry, drill cuttings, rock core; other solid or liquid material bailed, pumped, or otherwise removed from the borehole during drilling, installation, completion, and well development procedures; and fluids from material/equipment decontamination activities shall be disposed of by _____.

3.11 SURVEYS

Coordinates and elevations shall be established for each well/test hole. Horizontal coordinates shall be determined to the closest 1.0 foot and referenced to the State Plane Coordinate System, or Universal Transverse Mercator (UTM). If the State Plane Coordinate System/UTM is not readily available, an existing local grid system shall be used. A ground elevation to the closest 0.1 foot shall be obtained at each well. The highest point on the top of the riser pipe will serve as a measurement point. The elevation of the well shall reference this point, and shall be surveyed to the nearest 0.01 foot using the National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988. If the datum is not readily available, the existing local vertical datum shall be used. The location, identification, coordinates, and elevations of the well and monuments shall be plotted on maps with a scale large enough to show their location with reference to other structures.

3.12 WELL DECOMMISSIONING/ABANDONMENT

Any well disapproved by the Contracting Officer, or any well decommissioned/abandoned by the Contractor for any reason shall be decommissioned/abandoned according to the requirements of the State of _____, ASTM D 5299, and the requirements of these specifications. Well decommissioning/abandonment includes the removal of all materials left in the borehole/well, excluding the filter pack, and including backfill materials, casing, screen, and any other material placed into the hole before the decision was made to abandon the borehole/well. Test holes decommissioned/abandoned for any reason shall be grouted from the bottom to within _____ feet of the top of the ground surface according to the protocol for grout/bentonite placement established in paragraph Grout Placement, using the grout mix specified in paragraph CEMENT AND BENTONITE GROUT. The top _____ feet shall be backfilled with material appropriate for the intended land use. Mmaintain a well decommissioning/abandonment record as specified in paragraph Well Decommissioning/Abandonment Records. Groundwater levels, if encountered before the decision is made for decommissioning/abandonment, shall be measured in all borings prior to backfilling. These water levels shall be included in the well decommissioning/abandonment records. No well shall be decommissioned/abandoned without the approval of the Contracting Officer.

3.13 DOCUMENTATION AND QUALITY CONTROL REPORTS

Establish and maintain documentation and quality control reports for well construction and development to record the desired information and to assure compliance with contract requirements, including, but not limited to, the following:

3.13.1 Borehole Logs

A borehole log shall be completed for each boring drilled. Borehole logs shall be prepared by the geologist present onsite during all well drilling

and installation activities. The log scale shall be 1 inch equals 1 foot. Copies of complete well logs shall be kept current in the field at each well site and shall be available at all times for inspection by the Contracting Officer. Information provided on the logs shall include, but not be limited to, the following:

a. Name of the project and site.

b. Boring/well identification number.

c. Location of boring (coordinates, if available).

d. Make and manufacturer's model designation of drilling equipment and name of drilling firm.

e. Date boring was drilled.

f. Reference data for all depth measurements.

g. Name of driller and name and signature of geologist preparing log.

h. Nominal hole diameter and depth at which hole diameter changes.

i. Total depth of boring.

j. Method of drilling, including sampling methods and sample depths, including those attempted with no recovery. Indication of penetration resistance such as drive hammer blows given in blows per 6 inches of driven sample tubes. Information shall include hammer weight and drop distance. Information such as rod size, bit type, pump type, etc., shall be recorded. A description of any temporary casing used, drill fluids and fluid additives used, if any, including brand name and amount used, along with the reason for and start (by depth) of its use shall be included. If measured, mud viscosities and weight shall be recorded.

k. Depth of each change of stratum. If location of strata change is approximate, it shall be so stated.

l. Description of the material of which each stratum is composed, in accordance with ASTM D 2488, and/or standard rock nomenclature in accordance with CED TR GL-85-3, as necessary. Soil parameters for logging shall include, but shall not be limited to, classification, depositional environment and formation, if known, Unified Soil Classification Symbol, secondary components and estimated percentages, color, plasticity, consistency (cohesive soil), density (non-cohesive soil), moisture content, structure and orientation, and grain angularity. Rock core parameters for logging shall include, but shall not be limited to, rock type, formation, modifier denoting variety (shaly, calcareous, siliceous, etc.), color, hardness, degree of cementation, texture, crystalline structure and orientation, degree of weathering, solution or void conditions, primary and secondary permeability, and lost core. The results of any chemical field screening shall also be included on the boring log. Classification shall be prepared in the field at the time of sampling. The results of visual observation of the material encountered, and any unusual odor detected shall also be duly noted and recorded.

m. Depth of any observed fractures, weathered zones, or any

abnormalities encountered.

n. Depth and estimated percent of drill fluid loss or lost circulation. Measures taken to regain drill water circulation. Significant color changes in the drilling fluid return.

o. Depth to water, and any non-aqueous phase liquids (NAPLs) and date measured before, during, and after each drilling shift, and prior to well installation. Provide and maintain at each well under construction a portable water, and NAPL level measuring device of sufficient length to measure the water /NAPL level to 165 foot depth. The device shall be available onsite at all times and measuring wire shall be graduated in 0.01 foot. The method of measuring the liquid level shall be noted on the boring log. Water and NAPL level measurements shall be taken to the nearest 0.01 foot. It shall be noted on the boring log if the boring was purged and allowed to recover at intervals during the installation, or that water used in drilling was allowed to dissipate into the formation prior to measuring the water level.

p. Box or sample number. Depths and the number of the core boxes and/or samples shall be recorded at the proper interval.

q. Percent Rock Core Recovery. The percent core recovery for the individual drill runs, if rock is cored, shall be shown.

3.13.2 Installation Diagrams

The well will not be accepted before the geologic logs and installation diagrams are received. The diagram shall illustrate the as-built condition of the well and include, but not be limited to, the following items:

a. Name of the project and site.

b. Well identification number.

c. Name of driller and name and signature of the geologist preparing diagram.

d. Date of well installation.

e. Description of material from which the well is constructed, including well casing/riser pipe and screen material, centralizer composition, if used, diameter and schedule of casing and screen, gradation of filter pack, lithologic description, brand name (if any), source, and processing method, and method of placement of the filter pack, bentonite seal type (pellets, granules, chips, or slurry), grout type (cement or high-solids bentonite) and type of protective cover (protective casing or flush-to-ground),if used.

f. Total depth of well.

g. Nominal hole diameter.

h. Depth to top and bottom of screen, and filter pack.

i. Depth to top and bottom of any seals installed in the well boring (grout or bentonite).

j. Type of cement and/or bentonite used, mix ratios of grout, method of placement and quantities used.

k. Elevations/depths/heights of key features of the well, such as top of well casing/riser pipe, top and bottom of protective casing (if used), ground surface, the depth of maximum frost penetration (frost line), bottom of well screen, top and bottom of filter pack, and top and bottom of seal.

l. Other pertinent construction details, such as slot size and percent open area of screen, type of screen, and manufacturer of screen.

m. Well location by coordinates. A plan sheet shall also be included showing the coordinate system used and the location of each well. A plan sheet is not required for each well installation diagram; multiple wells may be shown on the same sheet.

n. Static water level upon completion of the well.

o. Special problems and their resolutions; e.g., grout in wells, lost casing, or screens, bridging, etc.

p. Description of surface completion.

3.13.3 Well Development Records

A well development record shall be prepared for each well installed under the supervision of the geologist present during well installation operations. Information provided on the well development record shall include, but not be limited to, the following:

a. Date, time, and elevation of water level in the well, before development.

b. Depth to bottom of well, name of project and site, well identification number, and date of development.

c. Method used for development, to include size, type and make of equipment, bailer, and/or pump used during development.

d. Time spent developing the well by each method, to include typical pumping rate, if pump is used in development.

e. Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.

f. Volume of water added to the well, if any.

g. Volume and physical character of sediment removed, to include changes during development in color, and odor.

h. Source of any water added to the well.

i. Clarity of water before, during, and after development. Nephelometric turbidity unit (NTU) measurements.

j. Total depth of well and the static water level as per ASTM D 4750 from top of the casing, immediately after pumping/development, and 24 hours after development.

k. Readings of pH, specific conductance, DO, ORP, and temperature taken before, during, and after development.

l. Name and job title of individual developing well.

m. Name and/or description of the disposal facility/area, for the waters removed during development.

3.13.4 Geophysical Logs

Geophysical logs shall be prepared and completed for each well/test hole installed. Information provided on the logs shall include, as a minimum, the following:

a. Project name.

b. Test hole/well identification number.

c. Location of test hole (coordinates, and state, and county name).

d. Date test hole was drilled.

e. Fluid level in test hole before logging.

f. Fluid type and temperature.

g. Fluid resistance in ohm-m.

h. Casing type, diameter, and elevation (top and bottom).

i. Cement type and elevation (top and bottom).

j. Screen type, diameter, and elevation (top and bottom).

k. Date and time test hole was logged.

l. Reference elevation for all depth measurements.

m. Operator's name.

n. Equipment name and address.

o. Logger type and number.

p. Tool type.

q. Detector type (Nuclear Log only).

r. Source type (Nuclear Log only).

s. Source size (Nuclear Log only).

t. Source spacing (Nuclear Log only).

u. Tool length, cable head to detector.

v. Calibration.

w. Logging speed ft/min.

x. Log vert. scale ft/in.

y. Module settings.

z. Recorder settings.

aa. Document all field problems, including equipment malfunctions. This should include the steps taken to solve the problem and how the log might have been affected.

3.13.5 Well Decommissioning/Abandonment Records

Decommissioning/abandonment records shall include, as a minimum, the following:

a. Project name.

b. Well or test hole number.

c. Well/boring location, depth and diameter.

d. Date of decommissioning/abandonment.

e. Method of decommissioning/abandonment.

f. All materials used in the decommissioning/abandonment procedure and the interval in which test materials were placed.

g. Casing, and or other items left in hole by depth, description, and composition.

h. Description and total quantity of grout used initially.

i. Description and daily quantities of grout used to compensate for settlement.

j. Water or mud level (specify) prior to grouting and date measured.

k. The reason for decommissioning/abandonment of the well/test hole.

3.13.6 Project Photographs

Before, during, and after completion of work, the Contractor shall take a minimum of one view of each well installation. If rock is cored at the site, after the core has been logged, the core shall be dampened, if it has dried, neatly arranged in the core box, and photographed. Photographs shall be 3 by 5 inch color prints. The photographs shall be mounted and enclosed back-to-back in a double face clear plastic sleeve punched to fit standard three ring binders. Each color print shall show an information box, 1-1/2 by 3-1/2 inches. The box shall be typewritten and arranged as follows:

Project No. Contract No.

Contractor/Photographer:

Photograph No. Date/Time:

Description:

Direction of View:

3.13.7 Survey Maps and Notes

A tabulated list of all wells and monuments, copies of all field books, maps showing the locations, and elevations of all wells, datum used (e.g. state plane NAD27, NAD83, UTM, etc.), elevation datum, units of measurement, and all computation sheets shall be prepared as a submittal. The tabulation shall consist of the designated number of the well or monument, the X and Y coordinates, and all the required elevations. Also, a diagram showing where on the top of the well the elevation was determined by the surveyor shall be prepared.

WATER QUALITY ANALYSIS TABLE

Physical Characteristics

Color	Resistivity in ohms per cubic
Taste	centimeter and 25 degrees C.
Threshold odor number	pH value
Turbidity	Temperature

Chemical Characteristics (Expressed as mg/L)

Arsenic	Total Hardness as CaCO(3)
Barium	Endrin
Cadmium	Lindane
Chromium	Methoxychlor
Copper	Toxaphene
Lead	2-4-D
Mercury	2, 4, 5 TP Silvex
Selenium	Total Organic Halogens
Silver	TOC
Zinc	Sulphates as SO(4)
Fluoride as F	Chlorides as C1
Manganese as Mn (dissolved and total)	Bicarbonates as HCO(3)
Iron as Fe (dissolved and total)	Carbonates as CO(3)
Suspended Solids	Nitrates as NO(3)
Total Dissolved Solids	Alkalinity (methyl-orange)
Calcium as Ca	(Phenolphthalein) as CaCO(3)
Magnesium as Mg	Silica as SiO(2)
Sodium and Potassium as Na	

-- End of Section --

SECTION 33 24 00.10

WASTE WATER LIFT STATION TELEMETRY AND MONITORING SYSTEM

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI 05.1	(1992) Wood Poles
ANSI C2	(1997) National Electrical Safety Code

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2000) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C4	(1999) Poles - Preservative Treatment by Pressure Processes
AWPA M6	Brands Used on Forest Products

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS L-P-387	Plastic Sheet, Laminated, Thermosetting (for Designated Plates)
FS TT-C-490	Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD 461	Electromagnetic Emission and Suscepti bility Requirements for the Control of Electromagnetic Interference

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS/REA 50-18	Specification DT-5C for Wood Poles, Stubs

and Anchor Logs

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Equipment

Dimensional drawings, wiring and/or support frame drawings for field mounted equipment.

Fabrication and nameplate legend drawings, internal wiring and schematic drawings.

System block diagrams illustrating all components being supplied complete with control and power interconnections.

Outline drawings of panels and telemetry configuration.

Shop drawings shall include but not be limited to a block diagram of the remote terminal unit, control relay cabinet and the central processor. They shall show clearly how the individual components work together to give the performance specified. Items shall be indexed and individually annotated and marked with specification paragraph applicable.

SD-03 Product Data

Equipment

Manufacturer's data sheets shall be submitted for at least each individually specified piece of equipment. Where these data sheets do not clearly show compliance with the specification, typed inserts shall be added to provide such information. Items shall be indexed and individually annotated and marked with specification paragraph applicable.

SD-10 Operation and Maintenance Data

Hardware Manual

Operator's Manual

1.3 OPERATIONS AND MAINTENANCE DATA

Provide three copies of the manuals, bound in hardback, loose-leaf binders. Identify each manual's contents on the cover. The manuals shall include the names, addresses, and telephone numbers of each subcontractor instal ling equipment and systems, and of the nearest service representatives for each item of equipment and each system. Addresses of where to purchase parts for each piece of equipment shall also be included. The manuals shall have a table of contents and tab sheets. Place the tab sheets at the beginning of each chapter or section and at the beginning of each appendix. Update all manuals to include modifications made during installation, checkout, and acceptance. Manuals provided shall include:

1.3.1 Hardware Manual

Furnish a hardware manual describing all equipment provided, including:

a. General description and specifications
b. Installation and checkout procedures
c. Electrical schematics and layout drawings
d. Adjustment and calibration procedures
e. Manufacturer's repair parts list indicating sources of supply

1.3.2 Operator's Manual

The operator's manual shall provide all procedures and instructions for operation of the system, including:

a. System startup procedures
b. System configuration/reconfiguration procedures
c. Use of bulk loading device and PROM programmer (where applicable)
d. Alarm procedures
e. Recovery and restart procedures
f. Preventive maintenance schedule

PART 2 PRODUCTS

2.1 MATERIALS

Unless otherwise indicated, the materials to be provided under this specification shall be products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest design. All items of the same type or ratings shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

2.1.1 Equipment and Devices

Shall be compatible and operable in all respects with existing control and telemetry system by Aquatrol Corp., SCADA System and shall not impair reliability or operational functions of existing station alarm reporting system.

2.1.2 Workmanship and Design

The workmanship and design of this equipment shall conform to all national, state, and local electrical codes and ordinances which apply.

2.2 EQUIPMENT

Shall be in accordance with standards of NEMA and UL. All conduit and outside wiring shall be specified in Section 26 20 00, "Interior Distribution Systems."

2.3 VERIFICATION OF DIMENSIONS

The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all dimensions in the field. The Contracting Officer shall be advised on any discrepancy before any work is performed.

2.4 RESPONSIBILITY AND COORDINATION

It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The drawings and specifications are intended to include all details of a complete equipment installation for the purposes specified. The Contractor shall be responsible for all details which may be necessary to properly install, adjust, and place in operation, the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the specifications.

2.5 MISCELLANEOUS MATERIALS

Provide all hardware, software, control equipment, sensors, transducers, converters, transmitters, receivers, electronics, modules, switching, fuses, regulated power supplies, transformers, wiring, line protection equipment, control devices, power sources, and other materials even though not specifically mentioned herein, which are necessary for the proper oper ation so that the system shall perform the functions listed.

2.6 MANUFACTURER'S SERVICES

The services of factory trained, qualified service representatives of the equipment manufacturer shall be provided to inspect the complete equipment installation to insure that it is installed in accordance with the manu facturer's recommendations. They shall make all adjustments necessary to place the system in trouble-free operation and instruct the operating per sonnel in the proper care and operation of the equipment furnished. They shall spend a minimum of two weeks onsite completing the software programming and training all Government operators.

2.6.1 Maintenance Training

The Contractor shall provide at least eight hours of classroom and on-job instruction for up to eight Government personnel pertaining to the system equipment maintenance. The classroom will be provided by the Government.

2.7 NAMEPLATES

Each device and component unit shall be provided with a permanent engraved laminated plastic nameplate. Laminated plastic shall be 0.125-inch thick Melamine plastic conforming to FS L-P-387, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1-inch by 2.5-inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment name plates shall show the following information:

a. Manufacturer, type, and model number

b. Contract number and accepted date

c. Capacity or size

d. System in which installed

Interchangeable ring-type device plates with standard nomenclature shall be provide for all indicator lights, pushbuttons, and toggle and selector switches.

2.8 SPARE PARTS

Included in the bid shall be the following spare parts which shall be turned over to the Contracting Officer prior to final acceptance. Also provide a list of any recommended spare parts not indicated below.

1 - Plug-in circuit board for each type of control or telemetry module used.
1 - Remote terminal unit complete with radio transceiver.
1 - Time delay relay for each type used.
1 - Control relay of each type used.
2 - Sensors for each type used.
Lot - 10 percent spare indicating lights
Lot - 10 percent spare control fuses (1 box minimum)
2 - Pushbutton and selector switch for each type used.

Each item of electronic equipment shall be clearly labelled with descrip tion/function, etc., and sealed within a shock-resistant, anti-static plastic bag provided with moisture absorbing material.

2.9 MANUFACTURER'S GUARANTEE

The selected equipment manufacturer shall guarantee that the materials and workmanship of the equipment to be free from defects for a period of one year from date of equipment start-up, providing the equipment has been operated and maintained in accordance with the manufacturer's recommenda tions.

2.10 QUALITY ASSURANCE

2.10.1 Pressure-Treated Wood Pole Quality

Ensure the quality of pressure-treated wood poles. Each pole shall be permanently marked or branded by the producer, in accordance with AWPA M6 and RUS/REA 50-18.

2.11 DELIVERY, STORAGE, AND HANDLING

Stack poles stored for more than 2 weeks on creosoted or decay-resisting skids arranged to support the poles without producing noticeable distor tion. Store poles to permit free circulation of air; the bottom poles in the stack shall be at least one foot above ground level and growing vege tation. Do not permit decayed or decaying wood to remain underneath stored poles. Do not drag treated poles along the ground. Do not use pole tongs, cant hooks, and other pointed tools capable of producing indentation more than 1-inch in depth in handling the poles.

2.11.1 Wood Poles

ANSI 05.1 and RUS/REA 50-18 of Southern Yellow Pine. Poles shall be bored, and roofed before treatment. Poles shall be treated full length with chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) according to AWPA C1 and AWPA C4 as referenced in RUS/REA 50-18.
Poles shall be branded by manufacturer with manufacturer's mark and date of treatment, height and class of pole, wood species, preservation code, and

retention. Place the brand so that the bottom of the brand or disc is 10 feet from the pole butt for poles up to 50 feet long.

2.12 FIELD TESTS

The Contractor shall perform all field tests and shall provide all labor, equipment and incidentals required for testing, except that the Government will provide electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Government. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of telemetry and control equipment and each sensor will function not less than five times without a failure.

2.12.1 System Acceptance Test

Shall be performed to demonstrate compliance with the specification. Notice shall be given two weeks in advance of performing tests to the Contacting Officer for their desire to witness testing. Test shall include operation of all functions and equipment for a period of no less than 48 hours without any function or component failure. Submit a test plan for approval before performing the tests.

2.13 FUNCTIONAL REQUIREMENTS

2.13.1 System Overview

The existing system is a microcomputer based telemetry system by Aquatrol Corp. The primary task of this system is the monitoring of liquid levels, flows, pumps, electrical power and other miscellaneous equipment. It pro vides the means by which plant management and staff monitor the facility and are alerted to equipment failures, power outages, and other emergen cies.

2.14 MICROCOMPUTER TELEMETRY AND LOGGING SYSTEM

2.14.1 Alarms

The following alarms shall be annunciated, displayed, and logged on the existing computer display and printed for each lift station.

wet well - high level
wet well - low level
#1 pump - run time
#1 pump - auto
#2 pump - run time
#2 pump - auto
#3 pump - run time
#3 pump - auto
#4 pump - run time
#4 pump - auto

Intrusion/tamper alarm
Generator power
Commercial power
Load power

PART 3 EXECUTION

3.1 INSTALLATION

Shall be in accordance with and or as specified in Section 26 20 00, "Interior Distribution Systems."

3.2 COMPUTER HARDWARE REQUIREMENTS

3.2.1 Remote Terminal Units (RTU's)

The Remote Terminal Units (I/O multiplexers) shall be digital scanning devices which communicate volumes of data in a minimum amount of time at a maximum level of message security. The RTU's shall utilize solid state circuitry which shall be completely modular with plug-in circuit boards to facilitate versatility, reliability and maintainability. Remote Terminal Units shall be furnished for locations as specified. Communication to the central plant shall be over UHF radio at a minimum of 300 baud. Communication to RTU's in-plant shall be over a twisted pair at a minimum of 1200 baud.

3.2.1.1 RTU's

Shall be capable of reliable operation over a temperature range of 0-60 degrees C with relative humidity of 20 to 95 percent noncondensing. RTU's shall utilize a microprocessor with PROM and RAM memory to handle communi cation protocol, Bose-Chaudhuri error-checking of 8 check bits and input/output control. A self-diagnostic program with LED indicators shall be provided to indicate:

AC power on
Battery power available
Data transmission
Data reception
Modem signals

3.2.1.2 Input/Output

Shall meet the following minimum standards:

a. Digital Inputs (DI): Dry contact, either manually open or closed and optically isolated.

3.2.1.3 RTU Communication to the Central Computer

Shall be through a microprocessor-based communication controller in RS-232C format. Data rates shall be as required to maintain overall scan cycles of no greater than 30 seconds, and to ensure communication via radio to comply with radio transceiver and FCC requirements.

3.2.1.4 Data Transmission Security

As a minimum, the following security features shall be provided with each Data Transmission:

a. Format Checks: To insure proper sequencing on the format of the Data Words.
b. Bose-Chaudhuri or Equivalent Cyclic Redundancy Check (CRC): BCH detection scheme with a minimum of 8 checkbits added to the message

by a binary process of dividing the message data bits by a standard polynomial.

3.2.1.5 RTU Enclosure

NEMA ICS 6; provide in NEMA 3R, 4X-Stainless Steel, 4X-Fiberglass enclosure with 3-point latch and padlock. Access to controls including resetting shall be internal and not accessible from the exterior of the enclosure.

3.3 RADIO TELEMETRY EQUIPMENT

3.3.1 Telemetry Signals

The telemetry signals shall be sent and received over a radio telemetry system which shall operate in a half-duplex mode on a single UHF FM radio frequency. The radio equipment shall operate on a narrow band splinter frequency in the power radio service.

3.3.2 Telemetry System Manufacturer

Shall provide all radio path surveys necessary and shall design the radio telemetry system for at least 99.9 percent reliability. The system manufacturer shall also provide all assistance necessary to the system user for radio frequency co-ordination and FCC licensing procedures. It is the Government's intention to use the same frequency (143.550 MHz) presently being employed for lift station annunciation.

3.3.3 Radio Transceivers

Shall be new, 100 percent solid state current model FM 2-way radio units suitable for sending and receiving audio tones at a minimum of 300 baud (bits per second). Radio frequency (RF) power output of each radio transceiver shall be sufficient to transmit all signals reliably under the topographical conditions at the installation site. All radio equipment shall comply with FCC Parts 15, 21, 81, 89, 91, and 93. The minimum technical specifications of the radio shall be:

3.3.3.1 Transmitter

RF Power Output	10 watts adjustable to 1 watt minimum
Frequency Range	133-153 MHz
Frequency Stability	Plus or minus .0005 percent from - 30 degrees to 60 degrees C
Modulation	6F9, plus or minus 2.5 KHz for 100 percent modulation
FM Hum and Noise	Minus 60 db
Audio Response	Within +1 and -3db of 60db/octave pre-emphasis 300-3000 Hz/EIA
Audio Distortion	Less than 3 percent at 100 Hz

3.3.3.2 Receiver

Sensitivity (20 db quieting)	.35 uv
Selectivity	Minus 80 db at 30 KHz
Frequency Stability	.0005 percent from - 30 degrees C to 60 degrees C
Intermodulation	Minus 70 db
Spurious and Image Rejection	Minus 85 db

3.3.4 Radio Antennas Mast and Mountings

Provide the radio antennas mast and mountings for each site in the system. Instructions for installing these antennas shall be given by the manufacturer to insure a reliable system. The mast shall be 2-inches schedule 40 galvanized pipe, length as indicated, installed vertical. Mast height shall be sufficient to transmit to and receive data from the central transceiver. Particular importance shall be given to the correct installation of the antennas to give maximum lightning protection to the system.

3.4 Antennas

Shall be directional and in compliance with manufacturer's recommendations. They shall be of commercial quality, all aluminum construction and rated to withstand at least 100 MPH winds. Provide RG213U coaxial cable with weath erproof connectors between the antenna and radio transceiver at each location.

3.4.1 Directional Antenna

Type	3 element Yagi Type, forward gain of at least 7 db
Frequency range	133-153 MHz
Bandwidth	Same as above
VSWR	1.5 to 1 or less
Nominal impedance	50 ohms
Forward Gain (over half-wave dipole)	9.5 db
Polarization	Vertical
Vertical pattern beam width of single antenna (half of power points)	50 degrees
Horizontal pattern beam width of single antenna (half of power points)	62 degrees
Standard termination	Captive Type N male attached to end of

	flexible lead
Front to Back Ratio	20 db
Lightning Protection	Direct ground and separate transmission line lightning arrestor
Feedpoint method	Weatherproof gama match for coaxial feedline

3.5 REMOTE TERMINAL UNITS (RTU)

The remote terminal units of this system shall also house the radio transceivers and associated input/output components and shall communicate with the existing Central Transceiver.

3.5.1 Each remote terminal unit shall have LED's for on board diagnostics including the following conditions:

a. Data fail
b. Transmit data
c. Receiver data (data valid)
d. Carrier frequency present

3.5.2 The transceiver shall also include a watchdog timer with an adjustable time delay for reset and "DATA FAIL" purposes. The remote unit shall include board selectable addressing. The Master shall address and interrogate each remote unit in succession via UHF FM radio transceiver. All data shall be sent digitally and such transmission shall incorporate parity, framing error, address command type and CRC protocol as a minimum means of achieving reliable performance. Each remote shall be updated at least once each two minutes.

3.5.3 The RTU will operate in the quiescent mode and will only accept

information from or transmit information to the Master after recognizing its own address.

3.5.4 Each remote terminal unit shall include all necessary input/output modules to transmit/receive all required discrete signals and to make output a complete and functioning system in this application.

3.5.5 Each RTU shall be equipped with a circuit breaker and be protected with an electronic surge arrestor. Equipment shall meet the spike suscep tibility requirements of MIL-STD 461, Part 7, CS06. Provide protection near equipment in a separate metallic enclosure at ground potential and as necessary at the power panel to insure protection against surges. All RTU's shall be provided with gelled-electrolyte type emergency battery, automatic transfer and battery charger system to maintain telemetry com munications and on-board memory upon power outages of up to eight hours duration and not allow battery voltage to drop below 85 percent full vol tage.

3.6 LIFT STATION RTU'S

RTU's shall be provided in each of the lift stations each providing the following functions:

a. Transmit pump on-off indications to the microcomputer.

b. Transmit intrusion alarm to microcomputer.
c. Transmit high and low wet well level alarms to microcomputer.
d. Transmit alarm to the microcomputer when pump HOA switch is moved from auto position.
e. Transmit loss of AC power alarm to the microcomputer upon utility power failure and immediately transfer to battery backup.
f. Transmit auxiliary generator power available to microcomputer.
g. Transmit load power available to the microcomputer.
h. Transmit return-to-normal indications to the microcomputer for all alarm points.
i. Transmit pump run time to the microcomputer for display, logging, and accumulation of total flow.

3.7 Metal Preparation and Paint Finish

3.7.1 All metal enclosures and subassemblies shall be provided with a high quality finish which will maintain its appearance in a humid environment. the process shall produce a fine mecrocrystalline zinc calcium phosphate coating on all ferrous surfaces to insure excellent paint adhesion. The process shall produce a coating weight of 250/400 mg/square foot; meeting FS TT-C-490B, Type 1.

3.7.2 The process shall be (1) heavy duty alkaline cleaner to remove oils and grease, (2) water rinse, (3) zinc phosphate paint adhesion and corro sion resistance. Final finish shall be acrylic base enamel which shall be oven-baked for a minimum of 15 minutes at 290 degrees F. Manufacturer shall provide certification of this process if requested.

3.8 UNDERWRITERS LABORATORIES LISTING

All control panel(s) shall be listed by UL, for industrial control panels and shall bear the UL listing mark. The entire assembled panel(s) shall be listed, not just individual components. Manufacturer shall provide satis factory evidence that panels are listed with approval drawings.

3.9 INSTALLATION OF POLES

ANSI C2, NFPA 70, and to the requirements specified herein.

3.9.1 Wood

Pole holes shall be at least as large at the top as at the bottom and shall be large enough to provide 4 inches of clearance between the pole and the side of the hole.

a. Setting depth: Pole setting depths shall be as follows:

Length of Pole (feet)	Setting in Soil (feet)
40	6.0

b. Soil setting: "Setting in Soil" depths shall apply where pole holes are in soil, sand, or gravel or any combination of these.

c. Setting on sloping ground: On sloping ground, measure the depth of the hole from the low side of the hole.

d. Backfill: Tamp pole backfill for the full depth of the hole and mound the excess fill around the pole.

3.10 GROUNDING

Ground noncurrent-carrying parts of equipment. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.11 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --

SECTION 33 24 00.20

WATER TOWER TELEMETRY AND MONITORING SYSTEM

01/07

PART 1 GENERAL

1.1 REFERENCES

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1.2 SUBMITTALS

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indexed and individually annotated and marked with specification paragraph applicable.

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SD-10 Operation and Maintenance Data

Hardware Manual

Operator's Manual

1.3 OPERATIONS AND MAINTENANCE MANUALS

Provide three copies of the manuals, bound in hardback, loose-leaf binders. Identify each manual's contents on the cover. The manuals shall include the names, addresses, and telephone numbers of each subcontractor instal ling equipment and systems, and of the nearest service representatives for each item of equipment and each system. Addresses of where to purchase parts for each piece of equipment shall also be included. The manuals shall have a table of contents and tab sheets. Place the tab sheets at the beginning of each chapter or section and at the beginning of each appendix. Update all manuals to include modifications made during installation, checkout, and acceptance. Manuals provided shall include:

1.3.1 Hardware Manual

Furnish a hardware manual describing all equipment provided, including:

a. General description and specifications

b. Installation and checkout procedures

c. Electrical schematics and layout drawings

d. Adjustment and calibration procedures

e. Manufacturer's repair parts list indicating sources of supply

1.3.2 Operator's Manual

The operator's manual shall provide all procedures and instructions for operation of the system, including:

a. System startup procedures

b. System configuration/reconfiguration procedures

c. Use of bulk loading device and PROM programmer (where applicable)

d. Alarm procedures

e. Recovery and restart procedures

f. Preventive maintenance schedule

PART 2 PRODUCTS

2.1 MATERIALS

Unless otherwise indicated, the materials to be provided under this specification shall be products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest design. All items of the same type or ratings shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

2.1.1 Equipment and Devices

Shall be compatible and operable in all respects with existing control and telemetry system by Aquatrol Corp., SCADA System and shall not impair reliability or operational functions of existing station alarm reporting system.

2.1.2 Workmanship and Design

The workmanship and design of this equipment shall conform to all national, state, and local electrical codes and ordinances which apply.

2.2 EQUIPMENT

Shall be in accordance with standards of NEMA and UL. All conduit and outside wiring shall be specified in Section 26 20 00, "Interior Distribution Systems."

2.3 VERIFICATION OF DIMENSIONS

The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all dimensions in the field. The Contracting Officer shall be advised on any discrepancy before any work is performed.

2.4 RESPONSIBILITY AND COORDINATION

It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The drawings and specifications are intended to include all details of a complete equipment installation for the purposes specified. The Contractor shall be responsible for all details which may be necessary to properly install, adjust, and place in operation, the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the specifications.

2.5 MISCELLANEOUS MATERIALS

Provide all hardware, software, control equipment, sensors, transducers, converters, transmitters, receivers, electronics, modules, switching, fuses, regulated power supplies, transformers, wiring, line protection equipment, control devices, power sources, and other materials even though not specifically mentioned herein, which are necessary for the proper oper

ation so that the system shall perform the functions listed.

2.6 MANUFACTURER'S SERVICES

The services of factory trained, qualified service representatives of the equipment manufacturer shall be provided to inspect the complete equipment installation to insure that it is installed in accordance with the manu facturer's recommendations. They shall make all adjustments necessary to place the system in trouble-free operation and instruct the operating per sonnel in the proper care and operation of the equipment furnished. They shall spend a minimum of two weeks onsite completing the software pro- gramming and training all Government operators.

2.6.1 Maintenance Training

The Contractor shall provide at least eight hours of classroom and on-job instruction for up to eight Government personnel pertaining to the system equipment maintenance. The classroom will be provided by the Government.

2.7 NAMEPLATES

Each device and component unit shall be provided with a permanent engraved laminated plastic nameplate. Laminated plastic shall be 0.125-inch thick Melamine plastic conforming to FS L-P-387, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1-inch by 2.5-inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment name plates shall show the following information:

a. Manufacturer, type, and model number

b. Contract number and accepted date

c. Capacity or size

d. System in which installed

Interchangeable ring-type device plates with standard nomenclature shall be provide for all indicator lights, pushbuttons, and toggle and selector switches.

2.8 SPARE PARTS

Included in the bid shall be the following spare parts which shall be turned over to the Contracting Officer prior to final acceptance. Also provide a list of any recommended spare parts not indicated below.

1 - Plug-in circuit board for each type of control or telemetry module used.
1 - Remote terminal unit complete with radio transceiver.
1 - Time delay relay for each type used.
1 - Control relay of each type used.
2 - Sensors for each type used.
Lot - 10 percent spare indicating lights
Lot - 10 percent spare control fuses (1 box minimum)

2 - Pushbutton and selector switch for each type used.

Each item of electronic equipment shall be clearly labelled with descrip tion/function, etc., and sealed within a shock-resistant, anti-static plastic bag provided with moisture absorbing material.

2.9 MANUFACTURER'S GUARANTEE

The selected equipment manufacturer shall guarantee that the materials and workmanship of the equipment to be free from defects for a period of one year from date of equipment start-up, providing the equipment has been operated and maintained in accordance with the manufacturer's recommendations.

2.10 FIELD TESTS

The Contractor shall perform all field tests and shall provide all labor, equipment and incidentals required for testing, except that the Government will provide electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Government. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of telemetry and control equipment and each sensor will function not less than five times without a failure.

2.10.1 System Acceptance Test

Shall be performed to demonstrate compliance with the specification. Notice shall be given two weeks in advance of performing tests to the Contacting Officer for their desire to witness testing. Test shall include operation of all functions and equipment for a period of no less than 48 hours without any function or component failure. Submit a test plan for approval before performing the tests.

2.11 FUNCTIONAL REQUIREMENTS

2.11.1 System Overview

The existing system is a microcomputer based telemetry system by Aquatrol Corp. The primary task of this system is the monitoring of liquid levels, flows, pumps, electrical power and other miscellaneous equipment. It pro vides the means by which plant management and staff monitor the facility and are alerted to equipment failures, power outages, and other emergen cies.

2.12 MICROCOMPUTER TELEMETRY AND LOGGING SYSTEM

2.12.1 Alarms

The following alarms shall be annunciated, displayed, and logged on the existing computer display and printed for each water station:

water level - gallons
low water level - alarm
intrustion - alarm
power outage
data fail - alarm
high level - alarm
rate of fall alarm

The following alarms shall be capable of being annunciated, displayed, and logged on the computer display and printed (these are for future equipment):

WELL HOUSES

Well pump - run time
Well pump - status: Hand/Off/Auto (HOA)
Well pump - Fail
Commercial Power
Generator Power
Data fail
Intrusion

PART 3 EXECUTION

3.1 INSTALLATION

Shall be in accordance with and or as specified in Section 26 20 00, "Interior Distribution Systems."

3.2 COMPUTER HARDWARE REQUIREMENTS

3.2.1 Remote Terminal Units (RTU's)

The Remote Terminal Units (I/O multiplexers) shall be digital scanning devices which communicate volumes of data in a minimum amount of time at a maximum level of message security. The RTU's shall utilize solid state circuitry which shall be completely modular with plug-in circuit boards to facilitate versatility, reliability and maintainability. Remote Terminal Units shall be furnished for locations as specified. Communication to the central plant shall be over UHF radio at a minimum of 300 baud. Communication to RTU's in-plant shall be over a twisted pair at a minimum of 1200 baud.

3.2.1.1 RTU's

Shall be capable of reliable operation over a temperature range of 0-60 degrees C with relative humidity of 20 to 95 percent noncondensing. RTU's shall utilize a microprocessor with PROM and RAM memory to handle communi cation protocol, Bose-Chaudhuri error-checking of 8 check bits and input/output control. A self-diagnostic program with LED indicators shall be provided to indicate:

AC power on
Battery power available
Data transmission
Data reception
Modem signals

3.2.1.2 Input/Output

Shall meet the following minimum standards:

a. Digital Inputs (DI): Dry contact, either manually open or closed and optically isolated.

3.2.1.3 RTU Communication to the Central Computer

Shall be through a microprocessor-based communication controller in RS-232C format. Data rates shall be as required to maintain overall scan cycles of no greater than 30 seconds, and to ensure communication via radio to comply with radio transceiver and FCC requirements.

3.2.1.4 Data Transmission Security

As a minimum, the following security features shall be provided with each Data Transmission:

a. Format Checks: To insure proper sequencing on the format of the Data Words.

b. Bose-Chaudhuri or Equivalent Cyclic Redundancy Check (CRC): BCH detection scheme with a minimum of 8 checkbits added to the message by a binary process of dividing the message data bits by a standard polynomial.

3.2.1.5 RTU Enclosure

NEMA ICS 6; provide in NEMA 3R, 4X-Stainless Steel, 4X-Fiberglass enclosure with 3-point latch and padlock. Access to controls including resetting shall be internal and not accessible from the exterior of the enclosure.

3.3 RADIO TELEMETRY EQUIPMENT

3.3.1 Telemetry Signals

The telemetry signals shall be sent and received over a radio telemetry system which shall operate in a half-duplex mode on a single UHF FM radio frequency. The radio equipment shall operate on a narrow band splinter frequency in the power radio service.

3.3.2 Telemetry System Manufacturer

Shall provide all radio path surveys necessary and shall design the radio telemetry system for at least 99.9 percent reliability. The system manufacturer shall also provide all assistance necessary to the system user for radio frequency co-ordination and FCC licensing procedures. It is the Government's intention to use the same frequency (143.550 MHz) presently being employed for lift station annunciation.

3.3.3 Radio Transceivers

Shall be new, 100 percent solid state current model FM 2-way radio units suitable for sending and receiving audio tones at a minimum of 300 baud (bits per second). Radio frequency (RF) power output of each radio transceiver shall be sufficient to transmit all signals reliably under the topographical conditions at the installation site. All radio equipment shall comply with FCC Parts 15, 21, 81, 89, 91, and 93. The minimum technical specifications of the radio shall be:

3.3.3.1 Transmitter

RF Power Output	10 watts adjustable to 1 watt minimum

Frequency Range	133-153 MHz
Frequency Stability	Plus or minus .0005 percent from - 30 degrees to 60 degrees C
Modulation	6F9, plus or minus 2.5 KHz for 100 percent modulation
FM Hum and Noise	Minus 60 db
Audio Response	Within +1 and -3db of 60db/octave pre-emphasis 300-3000 Hz/EIA
Audio Distortion	Less than 3 percent at 100 Hz

3.3.3.2 Receiver

Sensitivity (20 db quieting)	.35 uv
Selectivity	Minus 80 db at 30 KHz
Frequency Stability	.0005 percent from - 30 degrees C to 60 degrees C
Intermodulation	Minus 70 db
Spurious and Image Rejection	Minus 85 db

3.3.4 Radio Antennas Mast and Mountings

Provide the radio antennas mast and mountings for each site in the system. Instructions for installing these antennas shall be given by the manufacturer to insure a reliable system. The mast shall be 2-inches schedule 40 galvanized pipe, length as indicated, installed vertical. Mast height shall be sufficient to transmit to and receive data from the central transceiver. Particular importance shall be given to the correct installation of the antennas to give maximum lightning protection to the system.

3.4 Antennas

Shall be directional and in compliance with manufacturer's recommendations. They shall be of commercial quality, all aluminum construction and rated to withstand at least 100 MPH winds. Provide RG213U coaxial cable with weath erproof connectors between the antenna and radio transceiver at each location.

3.4.1 Directional Antenna

Type	3 element Yagi Type, forward gain of at least 7 db
Frequency range	133-153 MHz
Bandwidth	Same as above
VSWR	1.5 to 1 or less
Nominal impedance	50 ohms

Forward Gain (over half-wave dipole)	9.5 db
Polarization	Vertical
Vertical pattern beam width of single antenna (half of power points)	50 degrees
Horizontal pattern beam width of single antenna (half of power points)	62 degrees
Standard termination flexible lead	Captive Type N male attached to end of
Front to Back Ratio	20 db
Lightning Protection	Direct ground and separate transmission line lightning arrestor
Feedpoint method	Weatherproof gama match for coaxial feedline

3.5 REMOTE TERMINAL UNITS (RTU)

The remote terminal units of this system shall also house the radio transceivers and associated input/output components and shall communicate with the existing Central Transceiver.

3.5.1 Each remote terminal unit shall have LED's for on board diagnostics including the following conditions:

a. Data fail
b. Transmit data
c. Receiver data (data valid)
d. Carrier frequency present

3.5.2 The transceiver shall also include a watchdog timer with an

adjustable time delay for reset and "DATA FAIL" purposes. The remote unit shall include board selectable addressing. The Master shall address and interrogate each remote unit in succession via UHF FM radio transceiver. All data shall be sent digitally and such transmission shall incorporate parity, framing error, address command type and CRC protocol as a minimum means of achieving reliable performance. Each remote shall be updated at least once each two minutes.

3.5.3 The RTU will operate in the quiescent mode and will only accept

information from or transmit information to the Master after recognizing its own address.

3.5.4 Each remote terminal unit
Shall include all necessary input/output modules to transmit/receive all required discrete signals and to make output a complete and functioning system in this application.

3.5.5 Each RTU shall be equipped with a circuit breaker and be protected with an electronic surge arrestor. Equipment shall meet the spike suscep tibility requirements of MIL-STD 461, Part 7, CS06. Provide protection near equipment in a separate metallic enclosure at ground potential and as necessary at the power panel to insure protection against surges. All RTU's shall be provided with gelled-electrolyte type emergency battery, automatic transfer and battery charger system to maintain telemetry com munications and on-board memory upon power outages of up to eight hours duration and not allow battery voltage to drop below 85 percent full vol tage.

3.6 WATER TOWER RTU'S

RTU's shall be provided in each of the ____ water towers, providing the following functions:

a. Transmit water level indications to the microcomputer.
b. Transmit intrusion alarm to microcomputer.
c. Transmit low level alarms to microcomputer.
d. Transmit return-to-normal indications to the microcomputer for all alarm points.
e. All RTU's must be interchangeable with each other.
f. All RTU's shall be field configurable with a laptop computer.
Provide all software required for configuring RTU's.

3.7 Metal Preparation and Paint Finish

3.7.1 All metal enclosures and subassemblies shall be provided with a high quality finish which will maintain its appearance in a humid environment. the process shall produce a fine mecrocrystalline zinc calcium phosphate coating on all ferrous surfaces to insure excellent paint adhesion. The process shall produce a coating weight of 250/400 mg/square foot; meeting FS TT-C-490B, Type 1.

3.7.2 The process shall be (1) heavy duty alkaline cleaner to remove oils and grease, (2) water rinse, (3) zinc phosphate paint adhesion and corro sion resistance. Final finish shall be acrylic base enamel which shall be oven-baked for a minimum of 15 minutes at 290 degrees F. Manufacturer shall provide certification of this process if requested.

3.8 UNDERWRITERS LABORATORIES LISTING

All control panel(s) shall be listed by UL, for industrial control panels and shall bear the UL listing mark. The entire assembled panel(s) shall be listed, not just individual components. Manufacturer shall provide satis factory evidence that panels are listed with approval drawings.

3.9 GROUNDING

Ground noncurrent-carrying parts of equipment. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.10 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --

SECTION 33 24 00

BOILER AND BOILER PLANT TELEMETRY AND MONITORING SYSTEM

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS L-P-387	Plastic Sheet, Laminated, Thermosetting (for Designated Plates)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD 461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Materials

Equipment

Dimensional drawings, wiring and/or support frame drawings for field mounted equipment.

Fabrication and nameplate legend drawings, internal wiring and schematic drawings.

System block diagrams illustrating all components being supplied complete with control and power interconnections.

Outline drawings of panels and telemetry configuration.

SD-03 Product Data

Equipment manufacturer's sheets

Submit for each specifed piece of equipment

SD-10 Operation and Maintenance Data

Hardware Maintenance Manual

Operator's Manual

Provide three copies of the manuals, bound in hardback, loose-leaf binders. Identify each manual's contents on the cover. The manuals shall include the names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and of the nearest service representatives for each item of equipment and each system. Addresses of where to purchase parts for each piece of equipment shall also be included. The manuals shall have a table of contents and tab sheets. Place the tab sheets at the beginning of each chapter or section and at the beginning of each appendix. Update all manuals to include modifications made during installation, checkout, and acceptance.

1.3 OPERATIONS AND MAINTENANCE MANUALS

1.3.1 Hardware Maintenance Manual

Furnish a hardware manual describing all equipment provided, including:

a. General description and specifications

b. Installation and checkout procedures

c. Electrical schematics and layout drawings

d. Adjustment and calibration procedures

e. Manufacturer's repair parts list indicating sources of supply

1.3.2 Operator's Manual

The operator's manual shall provide all procedures and instructions for operation of the system, including:

a. System startup procedures

b. System configuration/reconfiguration procedures

c. Use of bulk loading device and PROM programmer (where applicable)

d. Alarm procedures

e. Recovery and restart procedures

f. Preventive maintenance schedule

PART 2 PRODUCTS

2.1 MATERIALS

Unless otherwise indicated, the materials to be provided under this specification shall be products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest design. All items of the same type or ratings shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

2.1.1 Equipment and Devices

Shall be compatible and operable in all respects with existing control and telemetry system by _____ and shall not impair reliability or operational functions of existing station alarm reporting system.

2.1.2 Workmanship and Design

The workmanship and design of this equipment shall conform to all national, state, and local electrical codes and ordinances which apply.

2.2 EQUIPMENT

Shall be in accordance with standards of NEMA and UL. All conduit and outside wiring shall be specified in Section 26 51 00, "Interior Distribution Systems."

2.3 VERIFICATION OF DIMENSIONS

The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all dimensions in the field. The Contracting Officer shall be advised on any discrepancy before any work is performed.

2.4 RESPONSIBILITY AND COORDINATION

It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The drawings and specifications are intended to include all details of a complete equipment installation for the purposes specified. The Contractor shall be responsible for all details which may be necessary to properly install, adjust, and place in operation, the complete installation. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the specifications.

2.5 MISCELLANEOUS MATERIALS

Provide all hardware, software, control equipment, sensors, transducers, converters, transmitters, receivers, electronics, modules, switching, fuses, regulated power supplies, transformers, wiring, line protection equipment, control devices, power sources, and other materials even though not specifically mentioned herein, which are necessary for the proper oper ation so that the system shall perform the functions listed.

2.6 MANUFACTURER'S SERVICES

The services of factory trained, qualified service representatives of the equipment manufacturer shall be provided to inspect the complete equipment installation to insure that it is installed in accordance with the manufacturer's recommendations. They shall make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment furnished. They shall spend a minimum of two weeks on-site completing the software programming and training all Government operators.

2.6.1 Maintenance Training

The Contractor shall provide at least eight hours of classroom and on-job instruction for up to eight Government personnel pertaining to the system equipment maintenance. The classroom will be provided by the Government.

2.7 NAMEPLATES

Each device and component unit shall be provided with a permanent engraved laminated plastic nameplate. Laminated plastic shall be 0.125-inch thick Melamine plastic conforming to FS L-P-387, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1-inch by 2.5-inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment name plates shall show the following information:

a. Manufacturer, type, and model number

b. Contract number and accepted date

c. Capacity or size

d. System in which installed

Interchangeable ring-type device plates with standard nomenclature shall be provide for all indicator lights, push buttons, and toggle and selector switches.

2.8 SPARE PARTS

Included in the bid shall be the following spare parts which shall be turned over to the Contracting Officer prior to final acceptance. Also provide a list of any recommended spare parts not indicated below.

1 - Plug-in circuit board for each type of control or telemetry module used.

1 - Remote terminal unit complete with radio transceiver.

1 - Time delay relay for each type used.

1 - Control relay of each type used.

2 - Sensors for each type used.

Lot - 10 percent spare indicating lights

Lot - 10 percent spare control fuses (1 box minimum)

2 - Push button and selector switch for each type used.

Each item of electronic equipment shall be clearly labelled with descrip tion/function, etc., and sealed within a shock-resistant, anti-static plastic bag provided with moisture absorbing material.

2.9 MANUFACTURER'S GUARANTEE

The selected equipment manufacturer shall guarantee that the materials and workmanship of the equipment to be free from defects for a period of one year from date of equipment start-up, providing the equipment has been operated and maintained in accordance with the manufacturer's recommendations.

2.10 FIELD TESTS

The Contractor shall perform all field tests and shall provide all labor, equipment and incidentals required for testing, except that the Government will provide electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Government. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of telemetry and control equipment and each sensor will function not less than five times without a failure.

2.10.1 System Acceptance Test

Shall be performed to demonstrate compliance with the specification. Notice shall be given two weeks in advance of performing tests to the Contacting Officer for their desire to witness testing. Test shall include operation of all functions and equipment for a period of no less than 48 hours without any function or component failure. Submit a test plan for approval before performing the tests.

2.11 FUNCTIONAL REQUIREMENTS

2.11.1 System Overview

The existing system is a microcomputer based telemetry system by _____ _____. This system will monitor and control remote boiler plant flows, pressures, temperatures, water levels and status of boiler and plant equipment. It provides the means by which plant management and staff monitor the facility and are alerted to equipment failures, power outages, and other emergencies.

2.12 CENTRAL MICROPROCESSOR CONTROL, TELEMETRY AND LOGGING SYSTEM

Modify the existing central microprocessor control, telemetry and logging system located in Building 1700. Provide software modifications to provide minimal functional requirements of the system summarized as follows:

a. Automatic collection of operating data from remote sensors.

b. Processing of all incoming data.

c. Execution of all manual control commands.

d. The system shall provide lead/lag control for each boiler, whereby if the lead boiler indicates a failure, the second boiler shall automatically be brought on line.

2.12.1 Alarms

a. The following alarms shall be annunciated, displayed, and logged on the computer display and printed from each boiler:

High Drum Pressure
Low Drum Level
High Drum Level
Burner Failure
Boiler Failure

b. The following alarms shall be annunciated, displayed, and logged on the computer and printed from each boiler plant:

Boiler feedwater pump No. 1 failure
Boiler feedwater pump No. 2 failure
Low plant steam header pressure
Low fuel oil tank No. 1 level
Low fuel oil tank No. 2 level
Personnel door open (2 locations)
Low boiler fuel pressure
Boiler feedwater pump No. 1 hand off auto switch - Alarm in hand/off position
Boiler feedwater pump No. 2 hand off auto switch - Alarm in hand/off position

2.12.2 Displays

2.12.2.1 Master Menu

This shall provide the operator with a convenient list of all the available displays of system information and control functions and shall provide the ability to directly call up any display listed. It shall display on the console CRT after system initialization, and may be displayed at any time by pressing a single designated key. Existing system shall be modified and revised as necessary.

2.12.2.2 Boiler Display

This shall provide information regarding all system parameters for a given boiler. The display shall include the following:

a. Point name

b. Internal point number

c. Point description

d. Point type

e. Point location

f. Status (digital points)

g. Current value (analog points)

h. Additional parameters as appropriate: e.g., engineering units, alarm limits, range, etc.

2.12.2.3 Plant Display

This shall provide information regarding all system parameters for a given plant. The display shall include the following:

a. Point name

b. Internal point number

c. Point description

d. Point type

e. Point location

f. Status (digital points)

g. Current value (analog points)

h. Additional parameters as appropriate: e.g., engineering units, alarm limits, range, etc.

2.12.3 Graphics Package

The Contractor shall provide a single line color graphics diagram of each boiler indicating monitoring and alarm points and flow measurements, and diagrams for each plant. Provide CRT graphic displays as shown on the drawings or plates in addition to these required here.

2.12.3.1 Graphic Format

The graphics shall be formatted with lines representing various process and special figures illustrating major process elements.

2.12.3.2 CRT Display

Live, real-time data values shall be displayed on the CRT screen next to the corresponding process component via a high level linkage. Colors and blinking shall be used to designate special or alarm conditions.

2.13 REMOTE TELEMETRY UNITS (RTU'S)

The remote telemetry units (I/O multiplexers) shall be digital scanning devices with communicate volumes of data in a minimum amount of time at a maximum level of message security. The RTU's shall utilize solid state circuitry which shall be completely modular with plug-in circuit boards to facilitate versatility, reliability, and maintainability. Remote telemetry units shall be furnished for locations as specified. Communication to RTU's outside the plant shall be over UHF radio at a minimum of 1200 baud. Provided input/output module cards at each location with minimum capacity as follows:

Analog inputs:	36
Digital inputs:	96
Digital Outputs:	36

2.13.1 Reliable Operation

RTU's shall be capable of 99.7 percent reliable operation over a temperature range of 0-60 degrees C with relative humidity of 20 to 95 percent noncondensating.

2.13.2 Microprocessor With PROM and RAM Memory

RTU's shall utilize a microprocessor with PROM and RAM memory to handle communication protocol, Base Chaudhuri error-checking of 8 check bits and input/output control. A self-diagnostic program with LED indicators shall be provided to indicate:

AC power on
Battery power available
Data transmission
Data reception
Data fail

2.13.3 Input/Output

Shall meet the following standards:

a. Digital Inputs (DI): Dry contact, either manually open or closed and optically isolated.

b. Analog 4-20 mA.

c. Resistance temperature detectors - 100 ohm/4-20 mA.

d. Pulses proportional to flow with signal conditioner to convert to 4-20 mA.

2.13.4 System Interface Module (SIM)

RTU's shall be provided with a system interface module (SIM) installed in the front of the unit. Each SIM shall include a key pad and LCD display unit to allow operator to view all instantaneous data being transmitted to the central microprocessor control system located in Building 1700. Key pad shall be key locked and password corrected.

2.13.5 Radio Transceivers and Associated Components

The remote terminal units of this system shall also house the radio transceiver and associated input/output components and shall communicate with the central transceiver.

2.13.6 Watchdog Timer

The transceiver shall also include a watchdog timer with an adjustable time delay for reset and "DATA FAIL" purposes. The remote unit shall include board selectable addressing. The master shall address and interrogate each remote unit in succession via UHF FM radio transceiver. All data shall be sent digitally and such transmissions shall incorporate parity, framing error, address command type and CRC protocol as a minimum means of achieving reliable performance. Each remote telemetry unit shall be scanned in a maximum time of three seconds.

2.13.7 Quiescent Mode

The RTU will operate in the quiescent mode and will only accept information from or transmit information to the master after recognizing its own address.

2.13.8 Circuit Breaker and Electronic Surge Arrester

Each RTU shall be equipped with a circuit breaker and be protected with an electronic surge arrester. Equipment shall meet the spike susceptibility requirements of MIL-STD 461, Part 7, CS06. Provide protection near equipment in a separate metallic enclosure at ground potential and as necessary at the power panel to ensure protection against surges. All RTU's shall be provided with gelled-electrolyte type emergency battery, automatic transfer and battery charger system to maintain telemetry communications and on-board memory upon power outages of up to eight hours duration.

2.13.9 Enclosures

RTU equipment shall be installed in NEMA 12 wall mounted enclosure with front access door.

2.14 RADIO TELEMETRY EQUIPMENT

2.14.1 Telemetry Signals

The telemetry signals shall be sent and received over a radio telemetry system which shall operate in a half-duplex mode on a single UHF FM radio frequency. The radio equipment shall operate on a narrow band splinter frequency in the power radio service.

2.14.2 Radio Path Surveys

The telemetry system manufacturer shall provide all radio path surveys necessary and shall design the radio telemetry system for at least 99.9 percent reliability. The system manufacturer shall also provide all assistance necessary to the system user for radio frequency coordination and FCC licensing procedures.

2.14.3 Transceivers

The radio transceivers shall be new, 100 percent solid state current model FM 2-way radio units suitable for sending and receiving audio tones at up to 1200 baud (bids per second). All radio equipment shall comply with FCC Parts 15, 21, 81, 89, 91, and 93. The minimum technical specifications of the radio shall be:

2.14.3.1 Transmitter

RF Power Output	25 watts adjustable to 2 watt minimum
Frequency Range	(Contractor to obtain from the station)
Frequency Stability	Plus or minus .0005 percent from -30 degrees to 60 degrees C
Modulation	6F9, plus or minus 2.5 KHz for 100 percent modulation
FM Hum and Noise	Minus 60 db
Audio Response	Within +1 and -3 db of 60 db/octave emphasis 300-3000 Hz/EIA

Audio Distortion	Less than 3 percent at 1000 Hz

2.14.3.2 Receiver

Sensitivity (20db quieting)	.35 uv
Selectivity	Minus 80db at 30 KHz
Frequency Stability	.0005 percent from -30 degrees to 60 degrees C
Intermodulation	Minus 70db
Spurious & Image Rejection	Minus 85db

2.14.4 Antenna Mounting

Provide the radio antennas mast and mountings for each site in the system, Instructions for installing these antennas shall be give by the manufacturer to insure a reliable system. Unless specifically stated, the antennas shall be attached to existing buildings. Particular importance shall be given to the correct installation of the antennas to give maximum lightning protection to the system.

2.14.5 Antennas

Antennas shall be directional and in compliance with manufacturer's recommendations. They shall be of commercial quality, all aluminum construction and rated to withstand at least 100 mph winds. Provide RG213U coaxial cable with weatherproof connectors between the antenna and radio transceiver at each location.

2.14.5.1 Directional Antenna

Type	5 element Yagi Type, forward gain of at least 7 db
Frequency range	133 - 153 MHz
Bandwidth	Same as above
VSWR	1.5 to 1 or less
Nominal impedance	50 ohms
Forward Gain (over half-wave dipole)	9.5 db
Polarization	Vertical
Vertical pattern beam width of single antenna (half of power points)	50 degrees
Horizontal patter beam width of single antenna (half of power points)	62 degrees
Standard termination	Captive Type N male attached to end

	of flexible lead
Front to back ratio	20 db
Lightning protection	Direct ground and separate transmission line lightning arrestor
Feedpoint method	Weatherproof gama match for coaxial feedline

2.15 FIELD TRANSMITTERS AND SENSORS

2.15.1 General

2.15.1.1 Field Mounted Electronic Transmitter Measuring Device

Provide field mounted electronic transmitter measuring devices for flow, level, and pressure process measurements as specified. Transmitters shall transmit 4 to 20 mA DC analog signals or discreet 120 VAC signals to terminals in the remote telemetry units. Analog signals shall be in accordance with ISA standard S50.1. Provide sensing line valve manifolds as required. Temperature measurements shall be made by 100 ohm resistance temperature detectors.

2.15.1.2 Conduit and Wiring

Provide all required conduit and wiring between the remote telemetry units and field mounted devices. Signals to final control elements shall be discreet 120 VAC rated at 2 amps.

2.15.1.3 Test Equipment

Provide a complete set of test equipment to measure and simulate input and output signals of all components without disconnecting any wiring. Provide procedures for operating and testing the devices.

2.15.2 Steam Flow Meters

2.15.2.1 Flow Meters

Provide a low loss metering venturi element of the pressure differential producing type utilizing pure static pressure sensed between the inlet and the venturi throat. Size venturi for a maximum steam flow of 15,500 lbs. steam/hr at a pressure of 50 psig.

The flow element shall be cast iron conforming to Class 30 with throat lines made of stainless steel. The meter flanges shall be rated for 250 psi with a cold water working pressure to 275 psig for chilled water applications. The throat shall be 316 stainless steel with a closed annular pressure chamber at the throat.

The flow meter shall have a constant discharge coefficient at Reynolds numbers greater than 75,000.

The uncalibrated accuracy of the primary element shall be within plus or minus 0.75 percent of actual flow.

The differential pressure shall indicate flow changes only.

The meter permanent pressure loss shall not exceed 6 percent of the differential pressure produced by the element. The entrance section shall consist of a uniform arc of a circle, the radius of which shall be continuous with the throat.

The metering element shall have no debris, collecting cavities nor annular chambers, but a single pressure connection at the inlet and the throat. Provide vent ports and drains on a 90 degree plans to the metering tap.

Furnish a certified flow vs. differential pressure graph for approval and certified data substantiating elements performance. The data shall include:

1. Coefficient values and tolerance

2. Effects of upstream configuration

3. Headloss as a function of the velocity head

The guaranteed accuracy shall be no more than two standard deviations +0.5 percent of actual rate of flow corresponding to differential pressure produced. Factory test and calibrate each flow meter under this contract. The test facility shall be open to the Government to witness testing if required.

Provide a liquid differential smart pressure transmitter with range no greater than 125 percent of meter span. Transmitter turndown shall be no less than 100 to 1. The transmitter shall utilize a floating-cell design with a mirco-machined silicone sensor. Transmitter electronics shall be housed in a NEMA 4X explosion-proof enclosure.

2.15.3 Differential Pressure and Pressure Transmitters

2.15.3.1 Drum Level For Boilers

Provide differential pressure transmitters for indicated drum level. Installation shall be complete with all necessary nipples, reservoirs, etc., required for connections to the transmitter. Range shall be as required for the specific boiler.

2.15.3.2 Pressure Transmitters

Provide pressure transmitters for boiler fuel oil pressure, atomizing medium pressure, boiler feedwater pump discharge pressure, plant steam head pressure, and plant fuel oil pressure where required. Transmitters shall have an accuracy of plus or minus 0.5 percent, and shall have a 4-20 mA output. Range shall be as required for the specific process.

2.15.4 Temperature Sensors

Sensors for temperature shall be measured by platinum resistance thermometer sensors, calibrated to a temperature accuracy of 1 percent. Provide a stainless steel thermowell for each sensor. Provide a 4-20 mA signal condition for each sensor. Signal conditioner may be installed in the head of the RTD or in the RTU panel.

2.15.5 Makeup Water Flow

Provide a 1 inch disc meter to measure makeup water flow. Meter shall have

a bronze housing, synthetic rubber disc, with an operating pressure rating of 150 psig. Temperature rating shall be 250 degrees F. Maximum continuous flow range shall be 36 gpm.

2.15.5.1 Register

Meters shall be complete with a flow transmitter type register. Register shall provide a 4-20 mA signal proportional to flow.

2.15.6 Fuel Flow Meter

For the existing Kent-Metron fuel oil flow meters, provide an MDA-4607 pulse register that will produce 10 pulses per gallon. One flow meter exists for each boiler.

PART 3 EXECUTION

3.1 SENSING LINE PIPING

Provide 1/2 inch sensing lines for installing new instruments where required.

3.1.1 Sensing Lines to New Transmitters

Shall have isolating steel globe or ball valves as close as possible to the process connection end of the line. Sensing line connections to new instruments or transmitters shall be provided with union compression type fittings for ease of removal.

3.2 WELDING

All welding and welders qualifications shall be as specified in Section 15483, "Fuel Oil Handling System."

All piping and piping specialties shall be as specified in Section 15716, "Piping Valves and Specialties."

3.3 SUPERVISION AND TESTING

3.3.1 Service Engineer

Services of a service engineer shall be provide to advise on the installation of the field mounted controls, place them in service and calibrate them.

The services of factory trained, qualified service engineer of the telemetry equipment manufacturer shall be provided to inspect the complete equipment installation to insure that it is installed in accordance with the manufacturer's recommendations. They shall make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment furnished. They shall spend a minimum of one week onsite completing the software programming and training all the Government operators.

3.3.2 Field Tests

The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing, except that the Government will provide electric power required for the tests. All defective material

and workmanship disclosed shall be corrected by the Contractor at no cost to the Government. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of telemetry and control equipment and each sensor will function not less than five times without failure.

3.3.3 System Acceptance Test

Shall be performed to demonstrate compliance with the specification. Notice shall be given two weeks in advance of preforming tests to the Contracting Officer for their desire to witness testing. Test shall include operation of all functions and equipment for a period of no less than 48 hours without any function or component failure. Submit a test plan for approval before performing the tests.

3.4 DEMONSTRATION

Prior to startup of a system, all alarm devices shall be demonstrated to, and the operation of each approved by the Base Utilities Engineer.

3.5 TRAINING

3.5.1 Maintenance Training

The Contractor shall provide at least 16 hours classroom and on-the-job instruction for up to six Government personnel pertaining to the system equipment maintenance. The classroom will be provided by the Government.

3.5.2 Operation Training

The operational training shall include complete operation of the system, in conjunction with the operation manual, under the supervision and instruction of the Contractor. At least 24 hours of training shall be provided for up to 10 Government personnel. Operator training shall consist of a review of the operations manual; booting the system; how to change control setpoints; how to add/delete points from the system or logs, etc. Training shall encompass the control logic already done, with special emphasis on how to change, modify, or otherwise generate new control logic.

-- End of Section --

SECTION 33 30 00

SANITARY SEWERS

04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	(2007) Manual for Railway Engineering

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2005) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2003) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C606	(2006) Grooved and Shouldered Joints
AWWA C900	(2007) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA M23	(2002) Manual: PVC Pipe - Design and

Installation

AWWA M9 (1995) Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1 (1983; R 2006) Pipe Threads, General Purpose (Inch)

ASME B16.1 (2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250

ASME B18.2.2 (1987; R 2005) Standard for Square and Hex Nuts (Inch Series)

ASME B18.5.2.1M (2006) Metric Round Head Short Square Neck Bolts

ASME B18.5.2.2M (1982; R 2005) Metric Round Head Square Neck Bolts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M (2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 307 (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 47/A 47M (1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A 48/A 48M (2003) Standard Specification for Gray Iron Castings

ASTM A 536 (1984; R 2004) Standard Specification for Ductile Iron Castings

ASTM A 563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts

ASTM A 74 (2006) Standard Specification for Cast Iron Soil Pipe and Fittings

ASTM A 746 (2003) Standard Specification for Ductile Iron Gravity Sewer Pipe

ASTM C 443 (2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

ASTM C 478 (2007) Standard Specification for Precast Reinforced Concrete Manhole Sections

ASTM C 564 (2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and

	Fittings
ASTM C 828	(2006) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 923	(2007) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 924	(2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 94/C 94M	(2007) Standard Specification for Ready-Mixed Concrete
ASTM C 969	(2002) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 972	(2000; R 2006) Compression-Recovery of Tape Sealant
ASTM C 990	(2006) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 1784	(2007) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2321	(2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2002) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe

	Fittings, Schedule 80
ASTM D 2680	(2001) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(2006) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(2006) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 4101	(2007) Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM D 412	(2006a) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 624	(2000e1) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 477	(2007) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(2006a) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(2003) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(2007) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(2006a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2004) Hubless Cast Iron Soil Pipe and

	Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2004) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-60005	(Basic) Frames.Covers, Gratings, Steps, Sump and Catch Basin, Manhole

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals ____ inch lines of ductile-iron pipe or polyvinyl chloride (PVC) plastic pipe at the Contractor's option. Provide building connections _____ inch lines of cast iron soil pipe or polyvinyl chloride (PVC) plastic pipe at the Contractor's option. Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

1.2.2 Sanitary Sewer Pressure Lines

Provide pressure lines of ductile iron pressure pipe or polyvinyl chloride (PVC) plastic pressure pipe at the Contractor's option.

1.2.3 USACE Project

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. Replace damaged material and redo unacceptable work at no additional cost to the Government. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

Drawings of existing conditions, as specified.

SD-02 Shop Drawings

Drawings

Installation and As-Built drawings, as specified.

Precast concrete manhole
Metal items
Frames, covers, and gratings

Details, as specified.

SD-03 Product Data

Pipeline materials

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports

Reports

Test and inspection reports, as specified.

SD-07 Certificates

Portland Cement

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

Gaskets

Certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans as _____ are oil resistant.

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed.

Installing Contractor's License shall be current and be state certified or state registered.

1.4.2 Drawings

a. Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

b. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

c. Sign and seal As-Built Drawings by a Professional Surveyor and Mapper. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

1.5.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.5.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 30 00 CAST-IN-PLACE CONCRETE.

1.5.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

1.6 PROJECT/SITE CONDITIONS

Submit drawings of existing conditions, after a thorough inspection of the area in the presence of the Contracting Officer. Details shall include the environmental conditions of the site and adjacent areas. Submit copies of the records for verification before starting work.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Cast-Iron Soil Piping

2.1.1.1 Cast-Iron Hub and Spigot Soil Pipe and Fittings

ASTM A 74, service, extra heavy, with ASTM C 564 compression-type rubber gaskets.

2.1.1.2 Cast-Iron Hubless Soil Pipe and Fittings

CISPI 301 with CISPI 310 coupling joints.

2.1.2 Ductile Iron Gravity Sewer Pipe and Associated Fittings

2.1.2.1 Ductile Iron Gravity Pipe and Fittings

Ductile iron pipe shall conform to ASTM A 746, Thickness Class _____. Fittings shall conform to AWWA C110/A21.10 or AWWA C153/A21.53. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved by the Contracting Officer, for push-on joint. Fittings shall have strength at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter. Pipe and fittings shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness.

2.1.2.2 Ductile Iron Gravity Joints and Jointing Materials

Pipe and fittings shall have push-on joints or mechanical joints, except as otherwise specified in this paragraph. Mechanical joints only shall be used where indicated. Push-on joint pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111/A21.11. Mechanical joint requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111/A21.11.

2.1.3 Ductile Iron Pressure Piping

2.1.3.1 Ductile Iron Pressure Pipe and Fittings

Ductile-iron pipe shall conform to AWWA C151/A21.51, Thickness Class _____. Flanged pipe shall conform to AWWA C115/A21.15. Fittings shall conform to AWWA C110/A21.10 or AWWA C153/A21.53. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter. Pipe and fittings shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness.

2.1.3.2 Ductile Iron Pressure Joints and Jointing Materials

a. Joints, general: Joints for pipe and fittings shall be push-on joints or mechanical joints except as otherwise specified in this

paragraph. Joints shall be mechanical-joints where indicated. Joints shall be flanged joints where indicated. Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint. Grooved or shouldered type joints may be used in lieu of push-on joint or flanged joint, except where joint is buried.

b. Push-on joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111/A21.11.

c. Mechanical joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111/A21.11.

d. Flanged joints: Bolts, nuts, and gaskets for flanged connections shall be as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and shall conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated, and zinc-coated steel. Gasket for setscrewed flanges shall conform to the applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

e. Joints made with sleeve-type mechanical couplings: Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat, two follower rings, two resilient tapered rubber gaskets, and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. Middle ring shall be of cast-iron or steel, and the follower rings shall be of malleable iron or ductile iron. Cast iron shall conform to ASTM A 48/A 48M and shall be not less than Class 25. Malleable iron shall conform to ASTM A 47/A 47M. Ductile iron shall conform to ASTM A 536. Steel shall have a strength not less than that of the pipe. Gaskets shall be designed for long life and resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type; bolts and nuts shall be either of the following: bolts conforming to the tensile requirements of ASTM A 307, Grade A, with nuts conforming to the tensile requirements of ASTM A 563, Grade A; or round-head square-neck type bolts conforming to ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts conforming to ASME B18.2.2. Bolts shall be 5/8 inch in diameter; minimum number of bolts for each coupling shall be _____ for _____ inch pipe ,_____ for _____ inch pipe, and _____ for _____ inch pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Sleeve-type mechanical couplings shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

f. Grooved and Shouldered Type Joints: Grooved pipe ends Shouldered pipe ends and couplings shall conform to AWWA C606. Joint dimensions shall be as specified in AWWA C606 for rigid joints.

2.1.4 PVC Plastic Gravity Sewer Piping

2.1.4.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints. ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 8 inch through 48 inch diameters.

2.1.4.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.5 PVC Plastic Pressure Pipe and Associated Fittings

2.1.5.1 PVC Plastic Pressure Pipe and Fittings

a. Pipe and Fittings Less Than 4 inch Diameter: Pipe, couplings and fittings shall be manufactured of materials conforming to ASTM D 1784, Class 12454B.

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785, Schedule 80, with joints meeting requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified. Fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Push-On Joint: ASTM D 3139, with ASTM F 477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110/A21.10 or AWWA C111/A21.11. Iron fittings and specials shall shall be cement-mortar lined (standard thickness) in accordance with AWWA C104/A21.4.

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure. Fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467.

b. Pipe and Fittings 4 inch Diameter to 12 inch: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.5.2 PVC Plastic Pressure Joints and Jointing Material

Joints for pipe, 4 inch to 12 inch diameter, shall be push-on joints as specified in ASTM D 3139. Joints between pipe and fittings shall be push-on joints as specified in ASTM D 3139 or shall be compression-type joints/mechanical-joints as respectively specified in ASTM D 3139 and AWWA C111/A21.11. Each joint connection shall be provided with an

elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipe and fittings shall be as specified in AWWA C111/A21.11, respectively, for push-on joints and mechanical-joints.

2.1.6 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 18 inch through 120 inch. ASTM F 714, size 4 inch through 48 inch. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills. Fittings for High Density Polyethylene Pipe: ASTM F 894. Joints for high density polyethylene pipe: Rubber gasket joints shall conform to ASTM C 443.

2.1.7 Piping Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, piping shall conform to the specifications for pipelines conveying nonflammable substances in AREMA Eng Man, except as otherwise specified in this paragraph. For casing pipe provide ductile-iron pipe in lieu of cast-iron soil pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Precast Concrete Manholes & Glass-Fiber-Reinforced Polyester Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478 and be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION; base and first riser shall be monolithic.

2.2.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923 or ASTM C 990.

2.2.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Proplene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, psi	ASTM D 412	1840	2195	-
Elogation percent	ASTM D 412	553	295	350
Tear Resistance, ppi	ASTM D 624 (Die B)	280	160	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12

2.2.4 Metal Items

2.2.4.1 Frames, Covers, and Gratings for Manholes

FS A-A-60005, cast iron; figure numbers shall be as indicated:

a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A
Steps: Figure 19

b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.2.4.2 Manhole Steps

Zinc-coated steel, as indicated conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes les 4 feet deep.

2.2.4.3 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum

3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.2.4.4 Septic Tank Piping

Cast iron soil pipe and fittings.

2.2.4.5 Siphon for Septic Tank

Welded steel or close-grained cast iron free from flaws, of an approved standard design, and prompt and positive in action.

2.3 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 00 00 EARTHWORK. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building, unless otherwise indicated. Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 10 feet to a water main or service line. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 2 feet below bottom of water line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 10 feet on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 feet, horizontal distance, to the water line.

a. Sanitary piping installation parallel with water line:

1 Normal conditions: Sanitary piping or manholes shall be laid at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

2 Unusual conditions: When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

(aa) The top (crown) of the sanitary piping shall be at least 18 inches below the bottom (invert) of the water main.

(bb) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron

water pipe pressure tested in place without leakage prior to backfilling.

(cc) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of sanitary piping crossing a water line:

1 Normal conditions: Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

(2 Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(aa) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

(bb) Sanitary piping passing over water lines shall, in addition, be protected by providing:

(1). A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.

(2). Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

(3). That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section _____.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform

to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast Iron Soil Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for cast iron soil pipe joints and assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 Installation of Ductile Iron Gravity Sewer Pipe

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation and joint assembly.

a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11.

b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105/A21.5, using Class A, Class C polyethylene film.

3.1.2.3 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fittings have

dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer, as approved. Make grooved and shouldered type joints with the couplings previously specified for this type joint connecting pipe with the grooved or shouldered ends specified for this type joint and assemble in accordance with the recommendations of the coupling manufacturer, as approved. Groove pipe in the field only with approved groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings; secure approval for field-cut grooves before assembling the joint.

b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105/A21.5, using Class A, Class C polyethylene film.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.4 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.5 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of AWWA C605 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less Than 4 Inch Diameter:

1 Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

2 Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

3 Solvent-weld joints shall comply with the manufacturer's instructions.

b. Pipe 4 Inch Diameter Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.6 Pipeline Installation Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, install piping in accordance with the specifications for pipelines conveying nonflammable substances in AREMA Eng Man.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 30 00 CAST-IN-PLACE CONCRETE, 03 30 04 CONCRETE FOR MINOR STRUCTURES. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete

piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Perform field tests and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Section _____. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When

pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.

b. Low-pressure air tests: Perform tests as follows:

1 Clay pipelines: Test in accordance with ASTM C 828. Allowable pressure drop shall be as given in ASTM C 828. Make calculations in accordance with the Appendix to ASTM C 828.

2 Concrete pipelines: Test in accordance with ASTM C 924. Allowable pressure drop shall be as given in ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924.

3 Ductile-iron pipelines: Test in accordance with the applicable requirements of ASTM C 924. Allowable pressure drop shall be as given in ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924.

4 ABS composite plastic pipelines: Test in accordance with the applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

5 PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a

design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

1 A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

2 Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

3 Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

4 Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.2.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Test ductile-iron pressure lines in accordance with the requirements of AWWA C600 for hydrostatic testing. Leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; allow no leakage at joints made by other methods. Test concrete pressure lines in accordance with the recommendations in AWWA M9, Chapter 10, "Hydrostatic Testing and Disinfection of Mains." Leakage on concrete pipelines shall not exceed 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline. Test PVC plastic pressure lines in

accordance with the requirements of AWWA C605 for pressure and leakage tests, using the allowable leakage given therein.

3.2.4 Field Tests for Concrete

Field testing requirements are covered in Section _____

-- End of Section --

SECTION 33 40 00

STORM DRAINAGE UTILITIES

01/08

PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

1.1.1 Pipe Culverts and Storm Drains

The length of pipe installed will be measured along the centerlines of the pipe from end to end of pipe without deductions for diameter of manholes. Pipe will be paid for at the contract unit price for the number of linear feet of culverts or storm drains placed in the accepted work.

1.1.2 Storm Drainage Structures

The quantity of manholes and inlets will be measured as the total number of manholes and inlets of the various types of construction, complete with frames and gratings or covers and, where indicated, with fixed side-rail ladders, constructed to the depth of _____ feet in the accepted work. The depth of manholes and inlets will be measured from the top of grating or cover to invert of outlet pipe. Manholes and inlets constructed to depths greater than the depth specified above will be paid for as units at the contract unit price for manholes and inlets, plus an additional amount per linear foot for the measured depth beyond a depth of _____ feet.

1.1.3 Walls and Headwalls

Walls and headwalls will be measured by the number of cubic yards of reinforced concrete, plain concrete, or masonry used in the construction of the walls and headwalls. Wall and headwalls will be paid for at the contract unit price for the number of walls and headwalls constructed in the completed work.

1.1.4 Flared End Sections

Flared end sections will be measured by the unit. Flared end sections will be paid for at the contract unit price for the various sizes in the accepted work.

1.1.5 Sheeting and Bracing

Payment will be made for that sheeting and bracing ordered to be left in place, based on the number of square feet of sheeting and bracing remaining below the surface of the ground.

1.1.6 Rock Excavation

Payment will be made for the number of cubic yards of material acceptably excavated, as specified and defined as rock excavation in Section 31 00 00 EARTHWORK, measured in the original position, and computed by allowing actual width of rock excavation with the following limitations: maximum rock excavation width, 30 inches for pipe of 12 inch or less nominal diameter; maximum rock excavation width, 16 inches greater than outside

diameter of pipe of more than 12 inch nominal diameter. Measurement will include authorized overdepth excavation. Payment will also include all necessary drilling and blasting, and all incidentals necessary for satisfactory excavation and disposal of authorized rock excavation. No separate payment will be made for backfill material required to replace rock excavation; this cost shall be included in the Contractor's unit price bid per cubic yard for rock excavation. In rock excavation for manholes and other appurtenances, 1 foot will be allowed outside the wall lines of the structures.

1.1.7 Backfill Replacing Unstable Material

Payment will be made for the number of cubic yards of select granular material required to replace unstable material for foundations under pipes or drainage structures, which will constitute full compensation for this backfill material, including removal and disposal of unstable material and all excavating, hauling, placing, compacting, and all incidentals necessary to complete the construction of the foundation satisfactorily.

1.1.8 Pipe Placed by Jacking

Payment will be made for the number of linear feet of jacked pipe accepted in the completed work measured along the centerline of the pipe in place.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 346	(2001) Specification for Cast-in-Place Concrete Pipe

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges
AASHTO M 167M/M 167	(2005) Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches and Arches
AASHTO M 190	(2004) Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 198	(2005) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
AASHTO M 219	(1992; R 2004) Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M 243	(1996; R 2004) Field-Applied Coating of Corrugated Metal Structural Plate for

	Pipe, Pipe-Arches, and Arches
AASHTO M 294	(2007) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter

AMERICAN RAILWAY ENGINEERING & MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	(2007) Manual for Railway Engineering

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 716	(2003) Standard Specification for Ductile Iron Culvert Pipe
ASTM A 74	(2006) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A 742/A 742M	(2003) Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
ASTM A 760/A 760M	(2006) Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A 762/A 762M	(2000) Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A 798/A 798M	(2007) Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A 807/A 807M	(2002e1) Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
ASTM A 849	(2000; R 2005) Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM A 929/A 929M	(2001; R 2007) Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B 26/B 26M	(2005) Standard Specification for

	Aluminum-Alloy Sand Castings
ASTM B 745/B 745M	(1997; R 2005) Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C 1103	(2003) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 139	(2005) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 14	(2007) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 1433	(2007a) Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C 231	(2004) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(2007a) Standard Specification for Mortar for Unit Masonry
ASTM C 32	(2005) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 425	(2004) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 444	(2003) Perforated Concrete Pipe
ASTM C 478	(2007) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 506	(2007) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 507	(2007) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 55	(2006e1) Concrete Brick
ASTM C 564	(2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 62	(2005) Building Brick (Solid Masonry Units

	Made from Clay or Shale)
ASTM C 655	(2007) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 76	(2007) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 828	(2006) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 877	(2002; E 2005) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 923	(2007) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 924	(2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1999) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	(2004) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 1784	(2007) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	(2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

ASTM D 2729	(2003) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3034	(2006) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(2006) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 6938	(2007a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F 1417	(1992; R 2005) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
ASTM F 477	(2007) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	(2006a) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 714	(2006a) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(2003) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	(2007) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(2006a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-04 Samples

Pipe for Culverts and Storm Drains

Samples of the following materials, before work is started: _____.

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density
Frame and Cover for Gratings

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Concrete pipe shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION

and conform to ASTM C 76, Class I, II, III, IV, V, or ASTM C 655, D-Load.

2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

Reinforced arch culvert and storm drainpipe shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION and conform to ASTM C 506, Class A-II, A-III, A-IV.

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

Reinforced elliptical culvert and storm drainpipe shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION and conform to ASTM C 507. Horizontal elliptical pipe shall be Class HE-A, HE-I, HE-II, HE-III, HE-IV. Vertical elliptical pipe shall be Class VE-II, VE-III, VE-IV, VE-V, VE-VI.

2.1.1.3 Nonreinforced Pipe

Nonreinforced pipe shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION and conform to ASTM C 14, Class 1, 2, 3.

2.1.1.4 Cast-In-Place Nonreinforced Conduit

ACI 346, except that testing shall be the responsibility of and at the expense of the Contractor. In the case of other conflicts between ACI 346 and project specifications, requirements of ACI 346 shall govern.

2.1.2 Corrugated Steel Pipe

ASTM A 760/A 760M, zinc or aluminum (Type 2) coated pipe of either:

a. Type I, II pipe with annular, helical 2-2/3 by 1/2 inch corrugations.

b. Type IR, IIR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

2.1.2.1 Fully Bituminous Coated

AASHTO M 190 Type A and ASTM A 760/A 760M zinc or aluminum (Type 2) coated pipe of either:

a. Type I, II pipe with annular, helical 2-2/3 by 1/2 inch corrugations.

b. Type IR, IIR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

2.1.2.2 Half Bituminous Coated, Part Paved

AASHTO M 190 Type B and ASTM A 760/A 760M zinc or aluminum (Type 2) coated Type I, II pipe with annular, helical 2-2/3 by 1/2 inch corrugations.

2.1.2.3 Fully Bituminous Coated, Part Paved

AASHTO M 190 Type C and ASTM A 760/A 760M zinc or aluminum (Type 2) coated Type I, II pipe with annular, helical 2-2/3 by 1/2 inch corrugations.

2.1.2.4 Fully Bituminous Coated, Fully Paved

AASHTO M 190 Type D and ASTM A 760/A 760M zinc or aluminum (Type 2) coated Type I, II pipe with annular, helical 2-2/3 by 1/2 inch corrugations.

2.1.2.5 Concrete-Lined

ASTM A 760/A 760M zinc coated Type I corrugated steel pipe with annular, helical 2-2/3 by 1/2 inch corrugations and a concrete lining in accordance with ASTM A 849.

2.1.2.6 Polymer Precoated

ASTM A 762/A 762M corrugated steel pipe fabricated from ASTM A 742/A 742M Grade 10/10 polymer precoated sheet of either:

a. Type I, II pipe with annular, helical 2-2/3 by 1/2 inch corrugations.

b. Type IR, IIR pipe with helical 3/4 by 3/4 by 7-1/2 inch corrugations.

2.1.2.7 Polymer Precoated, Part Paved

ASTM A 762/A 762M Type I, II corrugated steel pipe and AASHTO M 190 Type B (modified), paved invert only, fabricated from ASTM A 742/A 742M Grade 10/10 polymer precoated sheet with annular, helical 2-2/3 by 1/2 inch corrugations.

2.1.2.8 Polymer Precoated, Fully Paved

ASTM A 762/A 762M Type I, II corrugated steel pipe and AASHTO M 190 Type D (modified), fully paved only, fabricated from ASTM A 742/A 742M Grade 10/10 polymer precoated sheet with annular, helical 2-2/3 by 1/2 inch corrugations.

2.1.3 Corrugated Aluminum Alloy Pipe

ASTM B 745/B 745M corrugated aluminum alloy pipe of either:

a. Type I, II pipe with annular, helical corrugations.

b. Type IA, IR, IIA, IIR pipe with helical corrugations.

2.1.3.1 Aluminum Fully Bituminous Coated

Bituminous coating shall conform to ASTM A 849 Type _____. Piping shall conform to AASHTO M 190 Type A and ASTM B 745/B 745M corrugated aluminum alloy pipe of either:

a. Type I, II pipe with annular, helical corrugations.

b. Type IA, IR, IIA, IIR pipe with helical corrugations.

2.1.3.2 Aluminum Fully Bituminous Coated, Part Paved

Bituminous coating shall conform to ASTM A 849 Type _____. Piping shall conform to AASHTO M 190 Type C and ASTM B 745/B 745M corrugated aluminum

alloy pipe of either:

a. Type I, II pipe with annular, helical corrugations.

b. Type IR, IIR pipe with helical corrugations.

2.1.4 Structural Plate, Steel Pipe, Pipe Arches and Arches

Assembled with galvanized steel nuts and bolts, from galvanized corrugated steel plates conforming to AASHTO M 167M/M 167. Pipe coating, when required, shall conform to the requirements of AASHTO M 190 Type A, AASHTO M 243. Thickness of plates shall be as indicated.

2.1.5 Structural Plate, Aluminum Pipe, Pipe Arches and Arches

Assembled with either aluminum alloy, aluminum coated steel, stainless steel or zinc coated steel nuts and bolts. Nuts and bolts, and aluminum alloy plates shall conform to AASHTO M 219. Pipe coating, when required, shall conform to the requirements of AASHTO M 190, Type A, AASHTO M 243. Thickness of plates shall be as indicated.

2.1.6 Ductile Iron Culvert Pipe

ASTM A 716.

2.1.7 Cast-Iron Soil Piping

Cast-Iron Soil Pipe shall conform to ASTM A 74, service-weight; gaskets shall be compression-type rubber conforming to ASTM C 564.

2.1.8 Perforated Piping

2.1.8.1 Concrete Pipe

Concrete pipe shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION and conform to ASTM C 444, and applicable requirements of ASTM C 14, Class _____.

2.1.8.2 Corrugated Steel Pipe

ASTM A 760/A 760M, Type III, zinc-coated.

2.1.8.3 Corrugated Aluminum Pipe

ASTM B 745/B 745M, Type III.

2.1.8.4 PVC Pipe

ASTM D 2729.

2.1.9 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

2.1.9.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.9.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.9.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.9.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.10 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.10.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.10.2 Corrugated PE Pipe

AASHTO M 294, Type S or D, for pipes 12 to 48 inches and AASHTO M 294, Type S or D, for pipes 54 to 60 inches produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class in accordance with AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
12	1.50	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
60	6.45	0.800

2.1.10.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

		Minimum Moment Of Inertia of Wall Section (in to the 4th/in)	
Nominal Size (in.)	Minimum Wall Area (square in/ft)	Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	8.08	0.202	0.165
42	7.81	0.277	0.227
48	8.82	0.338	0.277

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 929/A 929M.

2.2.2 Precast Reinforced Concrete Box

Precast reinforced concrete box shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION. Boxes subjected to highway loadings shall conform to ASTM C 1433.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for _____ psi concrete under Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE, 03 30 00 CAST-IN-PLACE CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air

content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed _____ gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C 139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to ASTM C 62, Grade SW; ASTM C 55, Grade S-I or S-II; or ASTM C 32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION and conform to ASTM C 478. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure, made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48/A 48M, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

2.3.7 Joints

2.3.7.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.7.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877.

2.3.7.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D 1056, Type 2 A1, B3, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.7.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.7.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.7.6 Corrugated PE Plastic Pipe

Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F 477. Soil tight joints shall conform to the requirements in AASHTO HB-17, Division II, Section 26.4.2.4. (e) for soil tightness and shall be as recommended by the pipe manufacturer.

2.3.7.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

2.3.7.8 Ductile Iron Pipe

Couplings and fittings shall be as recommended by the pipe manufacturer.

2.3.8 Flap Gates

Flap Gates shall be medium or heavy-duty with circular, rectangular opening and double-hinged. Top pivot points shall be adjustable. The seat shall be one-piece casr iron with a raised section around the perimeter of the waterway opening to provide the seating face. The seating face of the seat shall be cast iron, bronze, stainless steel, neoprene. The cover shall be one-piece cast iron with necessary reinforcing rib, lifting eye for manual operation, and bosses to provide a pivot point connection with the links. The seating face of the cover shall be cast iron, bronze, stainless steel, neoprene. Links or hinge arms shall be cast or ductile iron. Holes of pivot points shall be bronze bushed. All fasteners shall be either galvanized steel, bronze or stainless steel.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the storm drainage structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48/A 48M, Class 30B or 35B. Shape and size shall be as indicated.

2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.7 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.7.1 Concrete, Clay, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443. Test requirements for joints in clay pipe shall conform to ASTM C 425. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

2.7.2 Corrugated Steel and Aluminum Pipe

A hydrostatic test shall be made on the watertight joint system or coupling band type proposed. The moment strength required of the joint is expressed as 15 percent of the calculated moment capacity of the pipe on a transverse section remote from the joint by the AASHTO HB-17 (Division II, Section 26). The pipe shall be supported for the hydrostatic test with the joint located at the point which develops 15 percent of the moment capacity of the pipe based on the allowable span in feet for the pipe flowing full or 40,000 foot-pounds, whichever is less. Performance requirements shall be met at an internal hydrostatic pressure of 10 psi, for a 10 minute period for both annular corrugated metal pipe and helical corrugated metal pipe with factory reformed ends.

2.8 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of 8 inches, as indicated.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus _____ inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between

unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Corrugated Metal Pipe

Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A 798/A 798M. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow v-shape. Bedding for corrugated structural plate pipe shall meet requirements of ASTM A 807/A 807M.

3.2.3 Ductile Iron and Cast-Iron Pipe

Bedding for ductile iron and cast-iron pipe shall be as shown on the drawings.

3.2.4 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain

adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Corrugated Steel and Aluminum Alloy	5
Concrete-Lined Corrugated Steel	3
Ductile Iron Culvert	3
Plastic	7.5

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced.

3.3.1 Concrete, Clay, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Elliptical and Elliptical Reinforced Concrete Pipe

The manufacturer's reference lines, designating the top of the pipe, shall be within 5 degrees of a vertical plane through the longitudinal axis of the pipe, during placement. Damage to or misalignment of the pipe shall be prevented in all backfilling operations.

3.3.3 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.4 Corrugated Metal Pipe and Pipe Arch

Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream, and with longitudinal laps on the sides. Part paved pipe shall be installed so that the centerline of bituminous pavement in the pipe, indicated by suitable markings on the top at each end of the pipe sections, coincides with the specified alignment of pipe. Fully paved steel pipe or pipe arch shall have a painted or otherwise applied label inside the pipe or pipe arch indicating sheet thickness of pipe or pipe arch. Any unprotected metal in the joints shall be coated with bituminous material as specified in AASHTO M 190 or AASHTO M 243. Interior coating shall be protected against

damage from insertion or removal of struts or tie wires. Lifting lugs shall be used to facilitate moving pipe without damage to exterior or interior coatings. During transportation and installation, pipe or pipe arch and coupling bands shall be handled with care to preclude damage to the coating, paving or lining. Damaged coatings, pavings and linings shall be repaired in accordance with the manufacturer's recommendations prior to placing backfill. Pipe on which coating, paving or lining has been damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced. Vertical elongation, where indicated, shall be accomplished by factory elongation. Suitable markings or properly placed lifting lugs shall be provided to ensure placement of factory elongated pipe in a vertical plane.

3.3.5 Structural-Plate Steel

Structural plate shall be installed in accordance with ASTM A 807/A 807M. Structural plate shall be assembled in accordance with instructions furnished by the manufacturer. Instructions shall show the position of each plate and the order of assembly. Bolts shall be tightened progressively and uniformly, starting at one end of the structure after all plates are in place. The operation shall be repeated to ensure that all bolts are tightened to meet the torque requirements of 200 foot-pounds plus or minus 50 foot-pounds. Any power wrenches used shall be checked by the use of hand torque wrenches or long-handled socket or structural wrenches for amount of torque produced. Power wrenches shall be checked and adjusted frequently as needed, according to type or condition, to ensure proper adjustment to supply the required torque.

3.3.6 Structural-Plate Aluminum

Structural plate shall be assembled in accordance with instructions furnished by the manufacturer. Instructions shall show the position of each plate and the order of assembly. Bolts shall be tightened progressively and uniformly, starting at one end of the structure after all plates are in place. The operation shall be repeated to ensure that all bolts are torqued to a minimum of 100 foot-pounds on aluminum alloy bolts and a minimum of 150 foot-pounds on galvanized steel bolts. Any power wrenches used shall be checked by the use of hand torque wrenches or long-handled socket or structural wrenches for the amount of torque produced. Power wrenches shall be checked and adjusted as frequently as needed, according to type or condition, to ensure that they are in proper adjustment to supply the required torque.

3.3.7 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.3.8 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Eng Man.

3.4 JOINTING

3.4.1 Concrete and Clay Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.

b. Grout: Grout shall be poured between band and pipe from the high

side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.

c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2 inch, thick and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.8 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.4.2 Corrugated Metal Pipe

3.4.2.1 Field Joints

Transverse field joints shall be designed so that the successive connection of pipe sections will form a continuous line free of appreciable irregularities in the flow line. In addition, the joints shall meet the general performance requirements described in ASTM A 798/A 798M. Suitable transverse field joints which satisfy the requirements for one or more of the joint performance categories can be obtained with the following types of connecting bands furnished with suitable band-end fastening devices: corrugated bands, bands with projections, flat bands, and bands of special design that engage factory reformed ends of corrugated pipe. The space between the pipe and connecting bands shall be kept free from dirt and grit so that corrugations fit snugly. The connecting band, while being tightened, shall be tapped with a soft-head mallet of wood, rubber or plastic, to take up slack and ensure a tight joint. The annular space between abutting sections of part paved, and fully paved pipe and pipe arch, in sizes 30 inches or larger, shall be filled with a bituminous material after jointing. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of fill material during the life of the installations. The type, size, and sheet thickness of the band and the size of angles or lugs and bolts shall be as indicated or where not indicated, shall be as specified in the applicable standards or specifications for the pipe.

3.4.2.2 Flexible Watertight, Gasketed Joints

Installation shall be as recommended by the gasket manufacturer for use of lubricants and cements and other special installation requirements. The gasket shall be placed over one end of a section of pipe for half the width of the gasket. The other half shall be doubled over the end of the same pipe. When the adjoining section of pipe is in place, the doubled-over half of the gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so that the gasket covers the end of pipe sections equally. Connecting bands shall be centered over adjoining sections of pipe, and rods or bolts placed in position and nuts tightened. Band Tightening: The band shall be tightened evenly, even tension being kept on the rods or bolts, and the gasket; the gasket shall

seat properly in the corrugations. Watertight joints shall remain uncovered for a period of time designated, and before being covered, tightness of the nuts shall be measured with a torque wrench. If the nut has tended to loosen its grip on the bolts or rods, the nut shall be retightened with a torque wrench and remain uncovered until a tight, permanent joint is assured.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding _____ inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not

exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding _____ inches.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with

those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 6938. When ASTM D 6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 6938 results in a wet unit weight of soil and ASTM D 6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 6938. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall conform to ASTM C 828. Low pressure air testing for concrete pipes shall conform to ASTM C 924. Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 250 gallons per inch in diameter per mile of pipeline per day, 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

3.8.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance

from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device. Ball, cylinder, or circular sections shall conform to the following:

1 A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

2 A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.

3 Center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

4 Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved by the Contracting Officer prior to use.

c. Pull-through device: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions.

e. Warranty period test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

3.9 FIELD PAINTING

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. After installation, clean steel covers and steel or concrete frames not buried in masonry or concrete to bare metal of mortar, dirt, grease, and other deleterious materials. Apply a coat of primer, _____, to a minimum dry film thickness of _____ mil; and apply a top coat, _____ to a minimum dry film thickness of _____ mils, color optional. Painting shall conform to

Section 09 90 00 PAINTS AND COATINGS. Do not paint surfaces subject to abrasion.

-- End of Section --

SECTION 33 63 13

EXTERIOR UNDERGROUND STEAM DISTRIBUTION SYSTEM

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 300	(2003) Inorganic Zinc-Rich Primer

ASME INTERNATIONAL (ASME)

ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.9	(2003) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2007) Power Piping
ASME B40.100	(2006) Pressure Gauges and Gauge Attachments

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 106/A 106M	(2006a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 134	(1996; R 2005) Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
ASTM A 135/A 135M	(2006) Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A 139/A 139M	(2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 167	(1999; R 2004) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 234/A 234M	(2007) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature

	Service
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C 518	(2004) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 533	(2007) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 591	(2007) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM D 2487	(2006) Soils for Engineering Purposes (Unified Soil Classification System)

NACE INTERNATIONAL (NACE)

NACE SP0169	(2007) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS L-S-125	(Rev B) Screening, Insect, Nonmetallic

1.2 DEFINITIONS

The following definitions are applicable:

1.2.1 Pre-engineered System

A complete underground heat distribution and condensate return system including all required components such as carrier pipes, steam pipe, high temperature hot water supply pipe, condensate return pipe, and high temperature hot water return pipe, fittings, anchors, pipe supports, insulation, protective casing, and cathodic protection, for the system supplied. The pre-engineered system does not include valve manholes and the piping and equipment inside the valve manholes; see Section 33 60 01 VALVE MANHOLES AND PIPING AND EQUIPMENT IN VALVE MANHOLES. The pre-engineered system shall include all piping and components to a point at least six inches inside the building and valve manhole. The UHDS shall not use any part of the building or valve manhole structure as an anchor point.

1.2.2 Direct-Buried

A system which is buried without the need for a field-fabricated protective enclosure such as a concrete trench or tunnel.

1.2.3 UHDS Types

1.2.3.1 Drainable-Dryable-Testable (DDT) Direct-Buried System

A factory-fabricated system including an air and water-tight outer protective casing, air space and an insulated carrier pipe. Drains and vents are provided at the end plates of the system (in manholes or buildings). The drains are normally plugged but the plugs can be removed to drain water which may leak into the air space if there is a failure in the casing or the carrier pipe. The vents allow water vapor to escape and provide a tell-tale sign of leakage.

1.2.4 UHDS Manufacturer Certification

The UHDS manufacturer is the company responsible for the design and manufacture of the pre-engineered system. The UHDS manufacturer directs the installation of their system and has a representative on the job site.Certification includes that the UHDS manufacturer regularly and currently manufactures direct-buried systems, and that the designs of the system and equipment to be provided for this project conform to specification requirements. This certification shall be an original signed by a principal officer of the UHDS manufacturer and shall be submitted at minimum of 2 weeks prior to start of work.

1.2.5 UHDS Manufacturer's Representative

The UHDS manufacturer's representative shall be a person who regularly performs the duties specified herein, is certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system, and shall be authorized by the manufacturer to make and sign the daily reports specified herein. The UHDS manufacturer's representative shall be under the direct employ and supervision of the UHDS manufacturer.

1.2.6 Corrosion Engineer

Corrosion engineer refers to a person who by knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control. Such person may be a licensed professional corrosion engineer or certified as being qualified by the National Association of Corrosion Engineers (NACE), if such licensing or certification includes 3 years experience in corrosion control on underground metallic surfaces of the type under this contract. NACE certification shall be technologist, corrosion specialist, or cathodic protection specialist. The corrosion engineer shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required. Once the submittals are approved and the materials delivered, the corrosion engineer shall revisit the site to ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The corrosion engineer shall supervise, inspect, and test the installation and performance of the cathodic protection system.

1.2.7 Pipe-Stress and System Expansion Calculations

Pipe-stress and system-expansion calculations for each expansion compensation elbow using a finite element computer generated three-dimensional analysis, not later than 7 days after notice to proceed.

Calculations (including heat loss calculations) shall demonstrate that pipe stresses from temperature changes are within the allowable requirements in ASME B31.1 and the anchors and the guides will withstand the resultant forces. Submitted detailed design layout drawings including the location of all anchors and guides. Layout shall also include all analysis node points. As a minimum, the computer analysis results include node stresses, forces, moments and displacements. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer in the employ of the UHDS manufacturer.

1.2.8 Cathodic Protection System Calculations

Design life calculations for cathodic protection system in accordance with NACE SP0169, not later than 7 days after notice to proceed. Calculations shall be stamped and signed by a NACE qualified corrosion engineer.

1.2.9 Manufacturer's Data Sheets

Manufacturer's data sheets on all components of the UHDS and the instrumentation required for thermal performance testing.

Manufacturer's data sheets for all coatings and for carrier pipe insulation, indicate thicknesses not later than 7 days after notice to proceed.

1.2.10 Work Plan

A proposed schedule of activities indicating when various items of work and tests are to be carried out and when the representative of the UHDS manufacturer shall be present at job site. The UHDS manufacturer shall submit a list of what characteristics shall be considered damaged or defective materials that must be replaced.

1.2.11 Quality Assurance Plan

Manufacturer's quality assurance plan for fabrication, delivery, storage, installation and testing of system.

1.2.12 Certificate of Compliance

Upon completion of the work, and before final acceptance, a notarized statement signed by a principal officer of both the UHDS manufacturer and the contractor, certifying that the system has been installed satisfactorily and in accordance with the contract drawings, specifications, UHDS manufacturer's detailed design layout drawings and with the UHDS manufacturer's recommendations.

1.2.13 Testing Firm Qualification

A Certificate of the Testing Firm Qualification from the independent testing firm or firms, not later than _____ days after notice to proceed, certifying that: weld examination methods and procedures, and the interpretation of ultrasound films will be performed in accordance with

ASME B31.1; the firm intends to utilize the proper film exposure, techniques, and penetrameter to produce density and geometric sharpness in sufficient clarity to determine presence of defects; and that all radiographic films will be reviewed and interpreted, and reading reports signed, by not less than a Certified American Society for Nondestructive Testing Level III Radiographer.

1.2.14 Welds

A Certification of Acceptability of all welds made in the field, upon completion of the project. This certification shall consist of a letter signed by an official of the independent testing firm or firms examining welds, stating that all provisions of this specification have been complied with, and that all welds inspected radiographically have met the acceptability standards specified.

1.2.15 Daily Written Report

A daily written report from the representative of the UHDS manufacturer whenever the representative is required to be on the jobsite. The report shall be checked for accuracy and the original shall be submitted no later than the next working day after the date of the report. One copy shall be forwarded to the UHDS manufacturer's main office. The report shall be signed by the representative. The report shall state whether or not the condition and quality of the materials and methods used and the installation of the system are in accordance with the contract drawings, specifications, and the UHDS manufacturers detailed design layout drawings and requirements. If anything connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the UHDS manufacturer's recommendations for corrective action and when the unsatisfactory condition is to be corrected. The daily report will track and report all unsatisfactory conditions and corrective measured being taken. The report shall identify any conditions that could result in an unsatisfactory installation, including such items as open conduit ends left in the trench overnight and improper valve manhole entries and changes required to the UHDS design due to interferences or conflicts, upon realization of interferences or conflicts. On a weekly basis the daily reports shall be reviewed, approved, signed and sealed by the registered Professional Engineer responsible for the system design and shall be submitted to the Contracting Officer.

1.2.16 Heat Distribution System, Data Package 2

The operation and maintenance manual for the heat distribution system shall list routine maintenance procedures, possible breakdowns and repairs, procedures for recording conduit temperatures biannually, and troubleshooting guides. Manual shall include as-built piping layout of the system including final elevations. Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 DESCRIPTION

1.3.1 Scope

The work includes the design and fabrication; furnishing; installing, and testing of a direct buried underground insulated heat-distribution system and insulated steam pipe, insulated high temperature hot water supply pipe, insulated steel condensate return pipe, insulated high temperature hot

water return pipe consisting of piping as indicated, cathodic protection system(where required by this specification), together with all fittings and appurtenances necessary for a complete and operable system. Gland type end seals shall not be permitted. Drainable, dryable, testable (DDT) systems with fiberglass casings shall not be provided.

1.3.2 UHDS Design

The UHDS manufacturer shall be responsible for the complete design of the UHDS, the product to be supplied, fabrication, witnessing installation and testing of the system within the design parameters established by the contract drawings and specifications, and in compliance with the detailed design. The complete design of the UHDS shall be sealed by a Professional Engineer in the employ of the UHDS manufacturer.A Certificate of Satisfactory Operation shall be submitted certifying that at least 3 systems installed by the UHDS manufacturer within the previous 10 years have and are operating satisfactorily for not less than 5 years, not later than _____ days after notice to proceed. The certificate shall indicate the location, type of system, size of system, point of contact (POC) including phone number, for information verification. This certificate of satisfactory operation shall be an original signed by a principal officer of the UHDS manufacturer.

1.3.3 Contract Drawings

The contract drawings accompanying this specification provide information on:

a. The size of carrier pipes, approximate length, and site location of the system.

b. The routing and elevation of the piping along the route.

c. Location and design of manholes.

d. The obstacles that must be avoided along the path.

e. Location of piping anchors (anchors will be no closer than 3 feet nor further than 5 feet from entrance to manholes and buildings) at manholes and/or buildings. The UHDS manufacturer shall incorporate any additional anchors as needed for their system.

f. Operating pressure and temperature of system.

1.4 SYSTEM REQUIREMENTS

1.4.1 Cathodic Protection

Cathodic protection shall be provided for systems with coated steel casings.

1.4.2 Operating Characteristics

The steam, high temperature hot water supply system shall have an operating temperature of _____ degrees F and an operating pressure of _____ psig. Condensate, High Temperature hot water return system shall have an operating temperature of _____ degrees F and an operating pressure of _____ psig.

1.4.3 Rated Characteristics

All thermal expansion calculations shall be computed for the supply and return piping using the following design characteristics and installation temperature. The system design conditions for steam, condensate, high temperature hot water, supply and/or return at a temperature of 366 degrees F and a pressure of 150 psig. For calculation purposes the installation temperature (the ambient temperature at the site) shall be no higher than a temperature of _____ degrees F.

1.4.4 Heat Distribution System design

A complete description of the Heat Distribution System design and assembly of the system, materials of construction and field installation instructions minimum of 2 days prior to the start of field measurements. Also submittal shall include sufficient system details required to show that the specified minimum insulation thickness has been met. A detailed design layout of the system (plan and elevation views) showing size, type, elevations and location of each component to be used in the system, the design and location of anchors, pipe guides, pipe supports, expansion loops, Z-bends, L-bends, end seals, leak plates, joint locations, pipe and insulation thickness and sizes, types, and movements, connection to manhole and building wall penetrations, and including, if applicable, transition point design to aboveground or other type systems. Also, if applicable, type and details of the cathodic protection system to be used. Detailed design layout drawings shall be prepared and approved by a registered Professional Engineer as certified by their stamp.

1.5 STANDARD PRODUCTS

Approval by Contracting Officer is required for products or services of the UHDS manufacturer. The design of the system and equipment provided for this project shall conform to specification requirements, shall be of current production and shall essentially duplicate systems that have been in satisfactory use for at least 5 years, prior to bid opening, at three locations. The systems must have been operated under pressure, temperature and site characteristics that are equal to or more severe than the operating conditions in this specification and must have distributed the same medium. The system shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.6 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Heat Distribution System design

SD-03 Product Data

Pipe

Insulation

Fittings

Cathodic protection

Anchors

Expansion joints

Coatings

Conduit

Field Connection of Casing Sections

SD-05 Design Data

Pipe-stress and system expansion calculations

Cathodic protection system calculations

Manufacturer's data sheets

SD-06 Test Reports

WSL system tests

SD-07 Certificates

Work plan

Quality assurance

Thermal performance testing

UHDS manufacturer certification

UHDS design

Certificate of compliance

Testing firm qualification

Welds

SD-10 Operation and Maintenance Data

Heat distribution system, Data Package 2

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Daily written report

1.7 SITE CLASSIFICATION

Classification of the site conditions for the UHDS was based on ASTM D 2487 and the following criteria: _____.

TABLE A
SITE CLASSIFICATION DEFINITION
BASED ON KNOWN UNDERGROUND WATER CONDITIONS

Site Classification	General Conditions for Classification
Severe	The water table is expected to be frequently above the bottom of the system and surface water is expected to accumulate and remain for long periods in the soil surrounding the system. OR The water table is expected to be occasionally above the bottom of the system and surface water is expected to accumulate and remain for long periods in the soil surrounding the system.
Bad	The water table is expected to be occasionally above the bottom of the system and surface water is expected to accumulate and remain for short periods (or not at all) in the soil surrounding the system OR The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for short periods in the soil surrounding the system.
Moderate	The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for short periods (or not at all) in the soil surrounding the system. OR The water table is expected never to be above the bottom of the system but surface water is expected to accumulate and remain for brief or occasional periods in the soil surrounding the system. OR The water table is expected never to be above the bottom of the system and surface water is not expected to accumulate or remain in the soil surrounding the system.

TABLE B
SITE CLASSIFICATION CRITERIA
BASED ON SUBSURFACE SOIL INVESTIGATION

Site Classif-ication	Water Table Level	Soil Types	Terrain	Precipitation Rates or Irrigation Practices in Area
SEVERE	Water table Within 1 foot of bottom of system	Any	Any	Any
	OR			
	Water table Within 5 feet of bottom of system	GC, SC CL, CH OH	Any	Any
BAD	Water table Within 5 feet of bottom of system	GW, GP, SW, SP	Any	Any
	OR			
	No groundwater encountered	GC, SC, SW, CH, OH	Any	Equivalent to 3 in. or more in any one month or 20 in. or more in one year.
MODERATE	No groundwater encountered	GM, SM, ML, OL, MH	Any	Equivalent to 3 in. or more in any one month or 20 in, or more in one year.
	OR			
	No groundwater encountered	GC, SC, CL, CH, OH	Any except low areas	Equivalent to less than 3 in. in any one month or less than 20 in. in one year.
	OR			
	No groundwater encountered	GW, GP, SW, SP	Any	Any
	OR			

TABLE B
SITE CLASSIFICATION CRITERIA
BASED ON SUBSURFACE SOIL INVESTIGATION

Site Classif-ication	Water Table Level	Soil Types	Terrain	Precipitation Rates or Irrigation Practices in Area
	No groundwater encountered	GM, SM, ML, SM,	Any	Equivalent to less than 3 in. in any one month or less than 20 in. in one year.

PART 2 PRODUCTS

2.1 FACTORY FABRICATED, DIRECT-BURIED, DRAINABLE, DRYABLE, TESTABLE (DDT) SYSTEMS

2.1.1 DDT Steam and High Temperature Hot Water Carrier Pipes

Requirements shall be in accordance with the "Heat Distribution Piping" paragraph.

2.1.2 DDT Condensate Carrier Pipes

Carrier piping for condensate return systems shall be steel, schedule 80. Pipe requirements shall be in accordance with the "Heat Distribution Piping" paragraph.

Do not locate condensate pipes in conduit casings which contain steam pipes or any other piping.

2.1.3 DDT Carrier Pipe Insulation

Carrier pipe insulation shall conform to minimum thicknesses and type listed in Tables 1 and 2 as required for temperature in carrier pipe specified under the "Rated Conditions" paragraph.

2.1.4 Insulation Banding and Scrim

Stainless steel bands and clips, at least 0.5 inches wide, ASTM A 167 (304 stainless steel), maximum spacing 18 inches shall be used over the scrim to secure the insulation onto the carrier pipe. A minimum of two bands are required for each 4 foot section of insulation. Vinyl-coated fiberglass scrim, FS L-S-125, Type II, Class 2, with 18 x 16 mesh (number of filaments per inch) and made of 0.013 inch diameter vinyl-coated fibrous glass yarn. Bands are used over the scrim to secure the insulation onto the carrier pipe.

2.1.5 Casing

Smooth-wall steel, electric resistance spiral welded, conforming to ASTM A 134, ASTM A 135/A 135M, or ASTM A 139/A 139M and the values tabulated below. Provide eccentric connectors as necessary between casing sections to provide drainage of casing section between manholes and between

manholes and buildings.

Casing Diameter (in.)	Minimum Thickness (in.)
6 - 26	0.250
27 - 36	0.250
37 - 42	0.250
46	0.250

2.1.6 Casing End Plates, Vents, and Drains

End plates shall be made of ASTM A 36/A 36M steel, minimum thickness 0.5 inches for conduit pipe sizes above 12 inches and 0.375 inches for conduit pipe sizes 12 inches and less. Provide 1 inch ASTM A 53/A 53M, Schedule 40, galvanized vent riser pipe on end plate vent opening. Vent pipe shall extend to top of manhole and terminate 12 inches above grade with a 180 degree bend. Provide one inch drain at the bottom and vent at the top. Construct with welded steel half coupling welded to the end plate, and brass plugs. Plug drains, do not plug vents.

2.1.7 Air Space

Provide continuous one inch minimum air space between carrier pipe insulation and casing.

2.1.8 Casing Coating

Fusion-bonded epoxy, minimum thickness 0.040 inches. Rated by coating manufacturer for continuous service for at least 25 years at temperatures of 230 degrees F and having a coefficient of expansion similar to that of steel. Coating shall be applied in accordance with the coating manufacturer's instructions. Factory-inspect for holidays and make repairs as necessary.

2.1.9 Coating of End Plates and conduit Sections Extending in Manholes

Zinc-rich coating that conforms to AASHTO M 300, Type IA except that volatile organic compounds shall not exceed 2.8 pounds per gallon. The zinc rich coating shall be applied in accordance with the coating manufacturer's requirements including surface preparation. No additional top coat shall be applied.

2.1.10 Carrier Pipe Guides

Maximum spacing 10 feet on centers, no more than 5 feet from pipe ends, minimum of three guides per elbow section. Guides shall be designed to allow thermal expansion without damage, provide proper pipe guiding, and to allow horizontal movement in two directions as required at expansion loops and bends. Design of supports shall permit flow of water and air vapor through the support. Pipe insulation shall extend thru the pipe guides and be protected by steel sleeves. Design of guides shall be such that no metal to metal contact exists between the casing and the carrier pipe. Insulation or non-metallic material used to ensure no metal to metal contact shall be designed to not be compressed by the weight of the carrier pipe when full of water.

2.1.11 Anchor Plates

Anchor plate shall be ASTM A 36/A 36M steel, welded to carrier pipe and

casing, 0.5 inches minimum thickness and shall include, passages for air flow and water drainage through the annular air space in the system. Exterior surface of the anchor plate shall be coated with the same coating material as the casing.

2.1.12 Field Connection of Casing Sections

Steel section conforming to casing specification, welded to casing sections, coated on all surfaces with UHDS manufacturer's coating field repair compound, and covered with a 0.05 inch minimum thickness polyethylene shrink sleeve designed for a service temperature exceeding 500 degrees F.

2.1.13 Manufacturer's Identification

Provide embossed brass or stainless steel tag hung by brass or stainless steel chain at each end of each conduit or insulated piping in the manholes and buildings. The tag shall identify UHDS manufacturer's name, date of installation, Government contract, and manufacturer's project number.

2.2 FACTORY FABRICATED, DIRECT-BURIED, WATER-SPREAD-LIMITING (WSL) SYSTEM

2.2.1 Condensate Carrier Pipes

Carrier piping for condensate return systems shall be steel, Schedule 80. Refer to paragraph entitled "HEAT DISTRIBUTION PIPING" for pipe requirements. Condensate piping shall not be located in casings which contain steam piping or any other piping.

2.2.2 Carrier Pipe Insulation

Conform to minimum thicknesses and type of insulation listed for WSL systems in Tables 1 and 2 as required for temperature in carrier pipe. Insulation shall consist of an inner layer of high temperature calcium silicate and an outer layer of polyurethane foam.

2.2.2.1 Calcium Silicate Insulation for Steam Systems

The calcium silicate insulation shall be a hydrous material satisfactory for temperatures to 1200 degrees F. Calcium Silicate insulation shall conform to ASTM C 533. The physical properties shall be as follows:

Density (dry) 13 lbs./cu. ft. (minimum)
Compressive Strength to produce 5 percent compression: 250 psi (For 1.5 inch thick sample)

Maximum Linear shrinkage after 24 hour soaking period at 1200 degrees F: 1.1 percent

Maximum Thermal Conductivity k k = BTU-IN/HR-FT2-DEG.F). Where k varies with temperature as shown:

Mean Temp	100	200	300	400
k	0.38	0.41	0.44	0.48
k(metric)	0.04	0.04	0.04	0.04

2.2.2.2 Polyurethane Foam Insulation for Steam and Condensate Systems

Polyurethane foam shall be in accordance with ASTM C 591. The polyurethane

foam shall completely fill the annular space between the calcium silicate insulation and the casing for the steam pipe and between the carrier pipe and the casing for condensate return system.

Polyurethane foam insulation shall also meet the following requirements:

a. Type: Two component urethane.

b. Compressive Strength: 25 psi parallel to rise (minimum at 50 percent compression).

c. Shrinkage: None at 30 to 70 degrees F.

d. Free Rise Density: 2 lbs/cubic foot.

e. Maximum aged k (90 degrees F/90 percent RH for 72 hours):

0.14 (BTU-IN/HR FT-2-DEG. F) at 75 degrees F, when tested in accordance with ASTM C 518.

f. Minimum Closed Cell Content: 90 percent

2.2.2.3 Insulation Concentricity

Carrier pipe shall be concentric in relation to the casing pipe. The allowable maximum deviation from center line of the carrier pipe shall be plus or minus 0.25 inch at the casing center point and plus or minus 0.06 inch at the end seals.

2.2.2.4 Insulated Fittings

Fittings shall be pre-insulated by manufacturer using the same insulation thickness and casing as the straight sections.

2.2.3 Manufacturer's Identification

Provide an embossed brass or stainless steel tag hung by a brass or stainless steel chain at each end of each casing or insulated piping in the manholes and buildings. The tags shall identify UHDS manufacturer's name and date of installation.

2.3 PIPE INSULATION FOR DIRECT BURIED HEAT DISTRIBUTION SYSTEMS

Materials containing asbestos are not permitted.

2.3.1 Insulation Thickness

The minimum thickness of insulation for the heat distribution system shall be in accordance with Tables 1 and 2 in which the insulations listed have passed the 96 hour boiling water test.

TABLE 1
MINIMUM PIPE INSULATION THICKNESS (inches)

For Steam (16 to 408 psig) and High Temperature
Hot Water Supply and Return (250 to 450 degrees F).

	INSULATIONS For Drainable/Dryable Systems			INSULATIONS For other Pre-Engineered Systems	
Nominal Pipe Diameter (inches)	Paroc	Epitherm Delta	Kaylo-10 Thermo-12 Super Caltemp	Calcium Silicate	WSL Polyurethane
1.0	2.0	2.5	4.0	N/A	N/A
1.5	2.0	2.5	4.0	N/A	N/A
2.0	2.5	3.5	4.5	N/A	N/A
2.5	2.5	3.5	4.5	N/A	N/A
3.0	3.0	4.0	5.0	1.0	+1.23
4.0	3.0	4.0	5.0	1.0	+1.22
5.0	3.0	4.0	5.0	N/A	N/A
6.0	3.5	4.5	5.5	1.5	+1.34
8.0	3.5	4.5	5.5	2.0	+1.21
10.0	4.0	5.0	6.0	2.5	+1.31
12.0	4.0	5.0	6.0	2.0	+1.29
14.0	4.0	5.0	6.0	N/A	N/A
16.0	4.0	5.0	6.0	N/A	N/A
18.0	4.0	5.0	6.0	N/A	N/A

TABLE 2
MINIMUM PIPE INSULATION THICKNESS (inches)
CONDENSATE RETURN
HIGH TEMPERATURE HOT WATER RETURN SYSTEM

Nominal Pipe Diameter (inches)	Paroc	Epitherm	Kaylo-10 Thermo-12 Super Caltemp	Polyurethane
1.0	1.5	2.0	3.0	N/A
1.5	1.5	2.0	3.0	N/A
2.0	1.5	2.0	3.0	0.77
2.5	1.5	2.0	3.0	N/A
3.0	2.0	2.5	3.5	1.05
4.0	2.0	2.5	3.5	1.05
5.0	2.0	2.5	3.5	N/A
6.0	2.5	3.0	4.5	1.32
8.0	2.5	3.0	4.5	N/A
10.0	3.0	4.0	5.0	N/A
12.0	3.0	4.0	5.0	N/A
14.0	3.0	4.0	5.0	N/A
16.0	3.0	4.0	5.0	N/A
18.0	3.0	4.0	5.0	N/A

2.4 HEAT DISTRIBUTION PIPING

2.4.1 Steam and High Temperature Hot Water Pipe

Pipe material shall be steel; seamless, ASTM A 53/A 53M, Grade B or ASTM A 106/A 106M, Grade B; or electric resistance welded ASTM A 53/A 53M, Grade B; Schedule 40. Standard weight permitted for pipe sizes 12 inches and above. ASTM A 53/A 53M, Type F furnace butt welded pipe is not allowed. No joints shall be allowed in the factory fabricated straight section of the carrier pipe. Factory fabricated piping sections as part of an expansion loop or bend shall have all welded joints 100 percent radiographed inspected in accordance with ASME B31.1. Radiographs shall be reviewed and interpreted by a Certified American Society for Nondestructive Testing (ASNT) Level III radiographer, employed by the testing firm, who shall sign the reading report.

2.4.1.1 Condensate Pipe

Steel; seamless, ASTM A 53/A 53M, Grade B or ASTM A 106/A 106M, Grade B, schedule 80; electric resistance welded ASTM A 53/A 53M, Grade B; Schedule 80. ASTM A 53/A 53M, Type F furnace butt welded pipe is not allowed. No joints shall be allowed in the factory fabricated straight section of the carrier pipe. Factory fabricated piping sections as part of an expansion loop or bend shall have all welded joints 100 percent radiographed inspected in accordance with ASME B31.1. Radiographs shall be reviewed and interpreted by an ASNT Certified Level II radiographer, employed by the testing firm, who shall sign the reading report.

2.4.1.2 Joints

Joints shall be butt-weld except socket-weld joints are permitted for pipe sizes 2 inches and smaller. Dye penetrant inspection may be used in place of 100 percent radiographic inspection for pipe sizes 2 inches and below. Indicate location and elevation of all field joints on detailed design layout drawings. Split-ring welding rings may be used.

2.4.2 Fittings

All welds in factory fittings shall be 100 percent radiographic inspected. All radiographs shall be reviewed and interpreted by a Certified ASNT Level III radiographer, employed by the testing firm, who shall sign the reading report. The Contracting Officer reserves the right to review all inspection records, and if any welds inspected are found unacceptable in accordance with ASME B31.1, the fitting shall be removed, replaced, and radiographically reexamined at no cost to the government.

2.4.2.1 Butt-Welded

Steel, ASTM A 234/A 234M, Grade B, ASME B16.9, same schedule as adjoining pipe. All elbows shall be long radius unless otherwise indicated. Tees shall be full size or reducing as required, having interior surfaces smoothly contoured. Split-ring welding rings may be used.

2.4.2.2 Socket-Welded

Forged steel, ASME B16.11, 2000 pound class will be used for pipe sizes 2 inch and below. Dye penetrant inspection may be used in place of 100 percent radiographic inspection of welded fittings for pipe sizes 2 inch and below.

2.5 EXPANSION JOINTS, LOOPS AND BENDS

Stresses shall be less than the maximum allowable stress from the Power Piping Code (ASME B31.1). Submit detailed design layout drawings and stress and anchor force calculations for all loops and bends. Show locations of all anchors, guides and supports. Base the calculations on rated characteristics (pressures and temperatures), specified herein, for both the supply and return lines.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 UHDS Design

The UHDS manufacturer is responsible for the complete design of the UHDS, the product to be supplied, fabrication, witnessing installation and testing of the system within the design parameters established by the contract drawings and specifications and in compliance with the detailed design. The complete design of the UHDS shall be prepared, signed, and sealed by a Professional Engineer in the employ of the UHDS manufacturer.

3.1.2 Installation, Inspection, and Testing

The pre-engineered system shall be installed, inspected, and tested in accordance with the contract drawings and specifications, the UHDS manufacturer's standard procedures, detailed design layout drawings and any directions given by the UHDS manufacturer's representative. All work described in paragraph "UHDS Manufacturer's Representative's Responsibilities" shall be performed in the presence of the UHDS manufacturer's representative.

3.1.3 Job Conditions

Phasing of demolition and construction, construction shall be in accordance with the provisions of Section 01 11 00 SUMMARY OF WORK, and as shown on contract drawings.

3.1.4 Interruption of Existing Service

The contractor shall arrange, phase and perform work and provide temporary facilities, materials, equipment, and connections to utilities, to assure adequate heat distribution service for existing installations at all times. Only such absolutely necessary interruptions as may be required for making connections shall be permitted, and only at such times when approval is obtained from the Contracting Officer. Interruptions to heat distribution service shall be only with prior approval, and be the minimum possible duration. All interruptions shall be between the hours of _____ thru _____, as scheduled under paragraph "PHASING" of Section 01 11 00 SUMMARY OF WORK, as approved by the Contracting Officer.

3.1.5 Connecting to Existing Work

Connect new work to existing work in a neat and workmanlike manner. Connection shall be made only in manholes. Where an existing structure must be cut or existing utilities interfere, such obstruction shall be bypassed, removed, replaced or relocated, restored and repaired. Any changes required to the UHDS design as a result of interferences or

conflicts must be approve by the UHDS designer and the Contracting Officer. Work disturbed or damaged shall be replaced to its prior condition, as required by Section 01 11 00 SUMMARY OF WORK.

3.1.6 Coordination

Coordinate the location of all items of equipment and work of all trades. Maintain operability and maintainability of the equipment and systems. Any relocation of equipment or systems to comply with the requirement of operability and maintainability shall be performed by the contractor at his cost.

3.1.7 Grading

Unless otherwise shown on the contract drawings or the detailed design layout drawings, steam/condensate and high temperature hot water supply/return lines shall be graded uniformly downward not less than 5.0 inches in 100 feet to the lower point of entry between manholes and/or building entries.

3.1.8 Variations

Any variations from the approved detailed design layout drawings must be submitted to the Contracting Officer for approval. Variations must be signed and sealed by the UHDS manufacturers' professional engineer responsible for the complete design of the UHDS.

3.1.9 Storage and Handling

Equipment and material placed on the job shall remain in the custody of the Contractor until final acceptance whether or not the Contractor has been reimbursed for the equipment and material by the Government.

The Contractor is solely responsible for the protection of the equipment and material against damage from any source. Protect all materials against entry of water and mud by installing watertight protection on open ends at all times. Sections of the casing or carrier piping found to have been subjected to full or partial submergence in water (which would allow the insulation to become wet) shall be immediately replaced. Protect materials at all times while stored or during installation from damage from UV light. Materials awaiting installation shall be completely covered to protect from UV degradation.

Place all damaged items in new operating condition or replace damaged items as determined and directed by the Contracting Officer, at no additional cost to the Government.

3.2 DEMOLITION

Perform work in accordance with requirements for phasing. Completely remove all pipe, valves, fittings, insulation, and all hangers including the connection to the structure and any fastenings. Seal all openings in manhole or building walls after removal of piping. All material and equipment removed shall become the property of the Contractor and shall be removed from Government property within one week and shall not be stored in operating areas. All flame cutting shall be performed with adequate fire protection facilities available as required by safety codes and Contracting Officer.

3.2.1 Asbestos Removal

Conform to Section 02 82 16.00 20 ENGINEERING CONTROL OF ASBESTOS CONTAINING MATERIALS.

3.3 PIPE, PIPING JOINTS AND FITTINGS

3.3.1 Welded Joints

Clean pipe and fittings inside and outside before and after assembly. Remove all dirt, scale, and other foreign matter from inside the piping by use of a pipe swab or pipe pig before connecting pipe sections, valves, equipment or fittings. Use eccentric connectors as necessary between casing sections to provide drainage of casing section between manholes and between manholes and buildings.

3.3.2 Fittings

All changes in direction shall be made with factory-built reinforced fittings. Field-fabricated fittings and miters are not permitted.

3.4 WELDING

The Contractor is entirely responsible for the quality of the welding and shall:

a. Conduct tests of the welding procedures used by his organization, determine the suitability of the procedures used, determine that the welds made shall meet the required tests, and also determine that the welding operators have the ability to make sound welds under standard conditions.

b. Comply with ASME B31.1.

c. Perform all welding operations required for construction and installation of the heat distribution system.

3.4.1 Qualification of Welders

Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1 and also as outlined below.

3.4.2 Examining Welders

The contractor shall examine each welder to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall:

a. Weld only in positions in which he/she has qualified.

b. Identify welds with the specific code marking signifying name and number assigned.

3.4.3 Examination Results

Provide the Contracting Officer with a list of names and corresponding code markings. Retest welders which fail to meet the prescribed welding

qualifications. Disqualify welders who fail the second test, for work on the project.

3.4.4 Beveling

Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.

3.4.5 Alignment

Utilize split welding rings for field joints on all carrier pipes above two inches to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe. Make field joints two inches and smaller with welding sockets.

3.4.6 Erection

Piping shall not be split, bent, flattened, or otherwise damaged either before, during, or after installation. Where the pipe temperature falls to 32 degrees F or lower, the pipe shall be heated to approximately 100 degrees F for a distance of one foot on each side of the weld before welding, and the weld shall be finished before the pipe cools to 32 degrees F.

3.4.7 Defective Welds

Replace and reinspect defective welds in accordance with ASME B31.1. Repairing defective welds by adding weld material over the defect or by peening shall not be permitted. Welders responsible for defective welds must be requalified.

3.4.8 Electrodes

Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during fabrication operations. Discard electrodes that have lost part of their coating.

3.4.9 Ultra Sound Testing

An approved independent testing firm regularly engaged in radiographic testing shall perform radiographic examination of 100 percent of the field welds in the carrier piping of direct-buried systems in accordance with ASME B31.1. Furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project, prior to installing casing field joints, backfilling and hydrostatic testing. All radiographs shall be reviewed and interpreted by a Certified American Society for Nondestructive Testing Level III radiographer, employed by the testing firm, who shall sign the reading report. The Contracting Officer reserves the right to review all inspection records, and if any welds inspected are found unacceptable they shall be removed, rewelded, and radiographically reexamined at no cost to the Government.

3.5 HEAT DISTRIBUTION SYSTEM INSTALLATION

The UHDS manufacturer's representative shall oversee the delivery, storage, and witness the installation and testing of the system. All work shall be

in strict accordance with the requirements specified herein and with the printed instructions of the manufacturer. These specifications shall take precedence over the printed instructions, if conflicts arise. Printed instructions shall be submitted to the Contracting Officer prior to system installation.

3.5.1 Verification of Final Elevations

Prior to covering the top of the casing with backfill material, but after all temporary supports have been removed and initial backfilling of the conduit system has been accomplished, the Contractor shall measure and record the elevation of the top of the casing in the trench. Elevations shall be taken at every completed field joint, 1/3 points along each pipe section and top of elbows. This measurement shall be checked against the contract drawings. These measurements shall confirm that the conduit system has been installed to the elevations shown on the contract drawings. Slope shall be uniform to within 0.1 percent. These measurements shall be recorded by the Contractor, included in the UHDS manufacturer's representative daily report, and given to the Contracting Officer prior to covering the casing with backfill material.

3.5.2 Excavation, Trenching, and Backfilling

Perform all excavation, trenching, and backfilling as required by the UHDS manufacturer's design and as specified in Section 31 00 00 EXCAVATION. Pipe shall lay on a 12 inch minimum sand bed and backfilled with sand on all sides to a minimum of 6 inches as measured from outside of casing. Foundation for system must be firm and stable. Foundation and backfill must be free from rocks or substances which could damage the system coating. Concrete anchor and thrust blocks must be installed in undisturbed earth. Backfilling must not commence until system has been satisfactorily pressure tested (both hydrostatic test of carrier and, for DDT systems, pneumatic test of casing. Minimum depth of burial to the top of the casing is 24 inches. Maximum depth of burial to the top of the casing is 10 feet.

3.5.3 UHDS Manufacturer's Representative Responsibilities

This shall be a person who regularly performs the duties listed below, is certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system, and shall be authorized by the manufacturer to make and sign the daily reports specified herein. The UHDS Manufacturer's representative shall be present at the job site and witness when the following types of work are being performed:

a. Inspection and unloading.

b. Inspection of trench prior to commencing installation of system.

c. Inspection of concrete anchors and thrust blocks.

d. Hydrostatic testing of carrier piping.

e. Field joint closure work.

f. Pneumatic testing of DDT system casing.

g. Holiday test of conduit coating.

h. Repair of any coating.

i. Installation of cathodic protection system.

j. Initial backfill up to 10 inches above the top of the casing.

k. Verification of final elevations. Elevation readings shall be witnessed and recorded.

l. Testing of cathodic protection system.

m. Operational tests

The UHDS manufacturer's representative is to notify the contractor immediately of any problems. If necessary, the UHDS manufacturer's representative will notify the Contracting Officer of problems requiring immediate action, otherwise the daily reports will note any problems encountered and indicate the corrective actions taken.

3.5.4 UHDS Manufacturer Representative's Reports

The UHDS manufacturer representative shall prepare and sign a written daily report. Present the original daily report to the Contracting Officer no later than one working day after it is prepared, and forward one copy to the manufacturer's main office. The report shall state whether or not the condition and quality of the materials used and the delivery, storage, installation and testing of the system are in accordance with the plans, specifications, and manufacturer's printed instructions and is satisfactory in all respects. When any work connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the UHDS manufacturer's recommendations for corrective action. The report shall identify any conditions that could result in an unsatisfactory installation, including such items as open conduit ends left in the trench overnight and improper manhole entries. The daily reports are to be reviewed, signed and sealed, on a weekly basis, by the registered engineer responsible for the system design. Signed and sealed copies of the daily reports shall be submitted with the payment request. Requests for payment shall be denied if the weekly review is not accomplished.

Upon completion of the work and before final acceptance, deliver to the Contracting Officer a notarized Certificate of Compliance signed by a principal officer of both the manufacturing and the contracting firm, stating that the installation is satisfactory and in accordance with plans, specifications, and manufacturer's instructions.

The UHDS manufacturer will retain a copy of all daily reports and the Certificate of Compliance for 5 years after final acceptance of the system by the government.

3.5.5 Protection

Protect casing coating from damage during unloading, storage, rigging and installation. Protect casing and carrier pipe ends from water intrusion during unloading, storage, rigging and installation. Protect piping and all accessories from damage due to exposure to UV light.

3.5.6 Defective Material

The UHDS Manufacturer's Representative shall take prompt action to remove from the site all damaged or defective material, subject to rejection in accordance with the quality assurance provisions included in the manufacturer's submittals and printed instructions, and shall order prompt replacement of such material.

3.5.7 Cathodic Protection

Provide cathodic protection for all steel casing systems and all buried exposed metal. Assume that 25 percent of the exterior of the UHDS is exposed metal. Cathodic protection systems shall have a minimum design life of 25 years and shall conform to Section 26 42 13.00 20 CATHODIC PROTECTION BY GALVANIC ANODE, Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT. Provide dielectric pipe flanges and unions and isolation devices at all points necessary. Provide test stations at grade on each section of the piping system. Isolation flanges and unions shall be rated for the service temperature and pressure.

3.6 TESTS

Demonstrate leak-tightness of all piping systems by performing pressure tests (hydrostatic, pneumatic) and operational tests. Pressure test heat distribution system in conformance with requirements stated in this specification and in printed instructions for the system supplied. Tests shall include carrier piping and casing. The carrier pipe shall be hydrostatically tested. Casings of DDT systems shall be pneumatically tested. Casing and end seals of WSL system will be tested for intrusion of water into the casing and insulation.

3.6.1 Holiday Testing of Direct-Buried System Steel Casings

Test entire exterior surface of the casing including the bottom exterior surface of the casing for faults in coating after installation in trench prior to backfilling. Use test method and voltage recommended by coating manufacturer. Repair any holidays found and retest. System shall not be backfilled until all holidays are eliminated.

3.6.2 Pneumatic, Hydrostatic and Operational Tests

Before conducting heat distribution system tests, flush lines with high pressure water until discharge shows no foreign matter and are deemed clean to the satisfaction of the Contracting Officer.

3.6.2.1 Pneumatic Test

The casing of DDT systems shall be pneumatically tested after welding and before field coating using air as the test medium. The test pressure shall be 15 psig. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the casing has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric

conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship T(1)P(2)=T(2)P(1), in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial (1) and final (2) readings. Pressure shall be measured with a mercury manometer, inclined manometer(slope gauge), or an equivalent device so calibrated as to be read in increments of not greater than 0.1 psi. Pressure shall be measured with a pressure gauge conforming to ASME B40.100. A throttling type needle valve or a pulsation dampener and shutoff valve may be included. The diameter of the face shall be at least 4.5 inches with a measurable range of 0 to 15 psig and graduations of not greater than 0.1 psig . During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested while under test pressure by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain proper safety precautions for air pressure testing at all times during the tests.

3.6.2.2 Hydrostatic Test

Carrier piping shall be tested hydrostatically before insulation is applied at field joints and shall be proved tight at a pressure 1.5 times the heat distribution supply pressure of _____ psig for 2 hours. There shall be no indication of reduction of pressure during the test. Pressure shall be measured with a device calibrated as to be read in increments of not greater than 5.0 psi.

3.6.2.3 Operational Test

Prior to acceptance of the installation, Contractor shall subject system to operating tests simulating actual operating conditions to demonstrate satisfactory functional and operating efficiency. These operating tests shall cover a period of not less than six hours for each portion of system tested. Conduct tests at times as the Contracting Officer may direct.

a. The contractor shall provide calibrated instruments, equipment, facilities and labor, at no additional cost to the Government.

b. When failures occur, repair problems then repeat test.

3.6.3 Deficiencies

Deficiencies discovered shall be corrected at the Contractor's expense, to the satisfaction of the Contracting Officer. Major deficiencies or failure to correct deficiencies, to the satisfaction of the Contracting Officer, may be considered cause for rejecting the entire installation.

3.7 VALVE MANHOLES

Valve manholes, piping, and equipment in valve manholes shall be in accordance with the contract drawings and Section 33 60 01 VALVE MANHOLES PIPING AND EQUIPMENT IN VALVE MANHOLES.

3.8 BURIED UTILITY WARNING AND IDENTIFICATION

3.8.1 Plastic Marking Tape

Polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines shall be supplied and installed. Tape shall be buried above the pipe during the trench backfilling operation and shall be buried approximately 12 inches below grade. Tape shall be 0.004 inch thick polyethylene, polyethylene with a metallic core. Tape shall be acid and alkali-resistant and shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elongation factor of 350 percent. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. The tape shall be of a type specifically manufactured for marking and locating metallic underground utilities. Tape shall be 6 inches wide and printed with a caution and identification of the piping system over the entire tape length. Tape shall be yellow with bold black letters. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

-- End of Section --

SECTION 33 63 23

EXTERIOR ABOVEGROUND STEAM DISTRIBUTION

04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.20	(1998; Addenda A 2000; R 2004) Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral Wound, and Jacketed
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.3	(2006) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2004) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1998; R 2006) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B16.9	(2003) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2007) Power Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 106/A 106M	(2006a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193/A 193M	(2007) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 194/A 194M	(2007) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2005) Standard Specification for Carbon Structural Steel
ASTM A 475	(2003) Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D 229	(2001) Rigid Sheet and Plate Materials Used for Electrical Insulation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MSS SP-70	(2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2005) Standard for Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(2002) Standard for Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

1.2 SYSTEM DESCRIPTION

Provide new and modify existing exterior aboveground steam and condensate piping system complete and ready for operation. Provide piping to and including the main steam pressure regulating valves, bypass valves, safety-relief valves, and high pressure traps within each building. Design pressure and temperature ratings of system components shall be for working pressure of 150 psig steam at 366 degrees F and 125 psig condensate at 250 degrees F. Provide new and modify existing exterior buried factory-prefabricated preinsulated steam and condensate piping under roads as specified in paragraph entitled "Buried Piping Under Roads."

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping

Valves

Strainers

Pipe hangers and supports

Traps

Gages

Steam flow meters

Expansion joints

Manhole drainers

SD-07 Certificates

Certification of welder's qualifications

SD-10 Operation and Maintenance Data

Manhole drainers, Data Package 2

Steam flow meters, Data Package 2

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Certification of Welder's Qualifications

Submit prior to site welding. Certifications shall not be more than one year old.

PART 2 PRODUCTS

2.1 PIPING

Steam piping includes piping upstream of steam traps. Condensate piping includes piping downstream of steam traps.

2.1.1 Steam Pipe

a. ASTM A 53/A 53M, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B); black steel. Provide Weight STD (Standard) for welding end connections. Provide Weight Class XS (Extra Strong) for threaded end connections.

b. ASTM A 106/A 106M, Grade A or B, black steel, Schedule No. 40 for pipe sizes through 10 inches, and minimum pipe wall thickness of 0.375 inch for pipe sizes 12 inches and larger for welding end connections. Provide Schedule 80 for threaded end connections.

2.1.2 Condensate Pipe

a. ASTM A 53/A 53M, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B); black steel, Weight Class XS (Extra Strong).

b. ASTM A 106/A 106M, Grade A or B, black steel, Schedule No. 80.

2.1.3 Buried Steel Piping to Cooling Well or Drain

Provide direct buried steel condensate pipe and fittings with exterior coal tar epoxy painting system.

2.2 FITTINGS

2.2.1 Threaded Fittings

ASME B16.11, or ASME B16.3, Class 150 for steam, Class 300 for condensate.

2.2.2 Socket Welding Fittings

ASME B16.11.

2.2.3 Buttwelding Fittings

ASME B16.9. Provide the same material and weight as the piping in which fittings are installed. Backing rings shall conform to ASME B31.1 and be compatible with materials being welded.

2.2.4 Eccentric Reducing Fittings

ASME B16.9. Provide the same material and weight as the piping in which fittings are installed. Provide for changes in horizontal steam piping sizes.

2.2.5 Flanges and Unions

2.2.5.1 Flanges

ASME B16.5, Class 150 or 300 as required.

2.2.5.2 Unions

ASME B16.39, Class 150 for steam, Class 250 for condensate.

2.2.6 Gaskets, Bolts, Nuts, and Washers

a. Gaskets: Provide spiral wound, non-asbestos gasket with centering ring per ASME B16.20. ASME B16.21, composition ring 0.0625 inch thick. Provide one piece factory cut ring gaskets for raised-face flanged joints, and full-face gaskets for flat-face flanged joints.

b. Bolts: ASTM A 193/A 193M, Grade B7. Extend a minimum of two full threads beyond the nut with the bolts tightened to the required

torque.

c. Nuts: ASTM A 194/A 194M, Grade 7, with Teflon coated threads.

d. Washers: Provide steel flat circular washers under bolt heads and nuts.

e. Electrically isolating (insulating) gaskets for flanges: Provide ASTM D 229 electrical insulating material of 1000 ohms minimum resistance. Provide one piece factory cut insulating gaskets between flanges. Provide silicon-coated fiberglass insulating sleeves between the bolts and the holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 0.125 inch thick high-strength insulating washers next to flanges and provide stainless steel flat circular washers over insulating washers and under bolt heads and nuts. Provide bolts 0.5 inch longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts in the horizontal position or not greater than 45 degrees above the horizontal position.

2.3 VALVES

Provide with stems in the horizontal position or not greater than 45 degrees above the horizontal position. Valves shall have flanged end connections, except sizes smaller than 2.5 inches may have union end connections, or threaded end connections with a union on one side of the valve.

2.3.1 Valves for Steam Service

Valves upstream of steam traps shall be steel body for minimum working pressure of ASME Class 150.

2.3.1.1 Gate Valves, Globe Valves, Angle Valves, and Check Valves

ASME B16.34, steel body, minimum of ASME Class 150. Provide swing check valves.

2.3.1.2 Steam Pressure Regulating Valves

Steel body, minimum of ASME Class 150, except as modified herein. Valve seats and disc shall be of replaceable heat-treated stainless steel. Valves shall be single seated, seat tight under dead end conditions, and move to the closed position in the event of pressure failure of the operating (controlling) medium. Provide strainer in inlet from external operating (controlling) medium. Valves shall be controlled by pilot valve with strainer at inlet from external pressure sensing piping. Valves shall be internally or externally steam traced for freeze protection. Valves shall be piston operated type or spring loaded diaphragm operated type with stainless steel springs.

2.3.1.3 Safety-Relief Valves

Minimum of ASME Class 150, with test lever. Valves shall have steel or copper alloy body. Valves shall have flanged inlet and outlet connections or threaded connections attached to threaded ASME Class 150 flanges. Valves shall be ASME rated for capacity indicated.

2.3.2 Valves for Condensate Service

Valves downstream of steam traps shall be for minimum working pressures of ASME Class 125.

2.3.2.1 Gate Valves

MSS SP-80, except sizes 2.5 inches and larger shall conform to MSS SP-70.

2.3.2.2 Globe and Angle Valves

MSS SP-80, except sizes 2.5 inches and larger shall conform to MSS SP-85.

2.3.2.3 Check Valves

MSS SP-80, except sizes 2.5 inches and larger shall conform to MSS SP-71. Provide swing check valves.

2.4 PIPING ACCESSORIES

2.4.1 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 43, of the adjustable type, except as specified or indicated otherwise. Tack-weld Type 39 pipe covering protection saddles to steel pipe for insulated piping. Provide steel support rods. The finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dip galvanized after fabrication. Rollers, bases, and saddles may be painted with two coats of aluminum or light gray paint rated for use on hot metal surfaces up to 450 degrees F in lieu of hot-dip galvanized. Provide stainless steel axles for rollers. Miscellaneous metal shall conform to ASTM A 36/A 36M, hot-dip galvanized after fabrication.

2.4.2 Strainers

Construct of steel in accordance with ASME B16.5 for minimum of ASME Class 150. Provide stainless steel strainer element with perforations of 0.016 inch for steam, 0.031 inch for steam mixed with condensate, and 0.047 inch for condensate (hot water). Provide blow-off outlet with pipe nipple, gate valve, and discharge pipe nipple.

2.4.3 Traps

Steel body, internals of stainless steel, minimum of ASME Class 150, and of the types indicated.

2.4.4 Gages

Provide single style pressure gage for steam with 4.5 inch dial, brass or aluminum case, bronze tube, gage cock, pressure snubbers, and syphon. Provide scale range for the intended service.

2.4.5 Pipe Sleeves

Provide where piping passes entirely through walls and floors. Provide sleeves of sufficient length to pass through entire thickness of walls and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or

core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

a. Sleeves in Masonry and Concrete Walls and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron sleeves. Core drilling of masonry and concrete may be provided in lieu of sleeves when cavities in the core-drilled hole are grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls and Floors: Provide 26 gage galvanized steel sheet.

2.4.6 Escutcheon Plates

Provide split hinge type metal plates for piping entering walls and floors in exposed spaces. Provide polished stainless steel plates or chromium-plated copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.4.7 Electronic Steam Flow Meter

Meter shall be for minimum working pressure of ASME Class 150. Meter shall include an orifice plate, pressure transmitter, indicator, and totalizer. Provide meter for measuring steam flow in pounds per hour. Meter shall be for installation and operation in horizontal position.

2.4.7.1 Orifice Plate

Provide differential producing type orifice plate with circular hole for insertion into the steam piping between two ASME B16.5 Class 300 welding neck orifice flanges. Orifice plate shall be Type 304 stainless steel. Furnish a dimensional report and flow versus differential curve with accuracy of plus or minus one percent over a 5 to 1 flow range. Orifice flanges shall have at least two radially-drilled and tapped holes for metering and two jack screws.

2.4.7.2 Pressure Transmitter

Provide solid state electronic type differential pressure transmitter. Transmitter shall utilize Type 316 stainless steel dual opposed rupture-proof bellows converted to produce a 4 to 20 mA dc output. Transmitter shall have a flow range of zero to 3000 pounds per hour of steam flow with accuracy of plus or minus 2 percent of the full scale over a 5 to 1 flow range. House transmitter in a weatherproof enclosure designed for wall mounting. Bellows body shall be rated for not less than 1000 psig. Power requirements are 120 volts ac. Provide transmitter complete with condensate reservoirs, steel three-valve manifold for isolation and nulling, and blowdown valves.

2.4.7.3 Indicator

Provide electric indicator to continuously indicate steam flow by means of a 4 to 20 mA dc electrical input signal. Indicator shall have pivot and jewel suspension and a mirrored scale with uniform graduations over a steam flow range of zero to 3000 pounds per hour.

2.4.7.4 Totalizer

Provide totalizer that linearizes a 4 to 20 mA dc electrical input signal into a digital signal scaled in pounds of steam flow, displays totalized steam flow on a six-digit nonresettable counter, and transmits each totalizer count to the output.

2.4.7.5 Output

An isolated (500 volts minimum) ac or dc switch closure rated at 50 volts dc or 40 volts RMS ac, one ampere minimum capacity. Duration of closure shall be not less than 0.04 second or more than 0.06 second.

2.4.7.6 Adjustments

Upon completion of the work, furnish the services of a competent technician regularly employed by the manufacturer of the flow meter to make the necessary adjustments to place the steam flow meter in operation and to conduct performance tests which demonstrate that the flow measuring equipment is functioning. Install the steam flow meter in accordance with manufacturer's recommendations.

2.4.8 Steam Flow Meters

Meter shall be for minimum working pressure of ASME Class 150 with steel pressure chambers or ASME Class 250 with cast-iron pressure chambers. Provide meter in horizontal pipe between two ASME B16.5 welding neck flanges. Provide rotary type meter for flow integration. Working parts shall be stainless steel. Steam flow shall cause rotation of a rotor assembly at a speed directly proportional to the rate of steam flow, as controlled by a damping liquid. The rotational speed of the rotor assembly shall be reduced by gearing in the damping liquid chamber. Final drive to the exterior counter shall be by driving magnets; stuffing box shall not be allowed. Counter shall be enclosed in a dust-tight cast-aluminum housing attached to, but easily removable from the meter. For steam pipe main sizes 4 inches and smaller, provide meter directly in the steam piping. For steam pipe main sizes larger than 4 inches, provide meter in shunt bypass piping with two ASME B16.5 Class 300 welding neck orifice flanges in the steam pipe main. In the shunt bypass piping, provide two flanged gate valves calibrated by the meter manufacturer. In the steam pipe main, provide 0.125 inch thick stainless steel orifice plate sized to suit meter capacity between two ASME B16.5 Class 300 welding neck orifice flanges. Provide six-dial counter with an electrical contactor to transmit signal to data terminal cabinet (DTC) for indicating steam flow in pounds. Provide remote totalizer for recording steam flow in pounds. Provide pressure compensated six-dial counter to automatically and continuously correct steam flow meter readings for steam pressure variations.

2.4.9 Steam Meter-Strain Gage Target Flow Type

a. Operation: The steam meter shall have four interconnected strain gages attached to the sensing tube, two in the forward side of flow, two on the reverse side of the flow, producing a four-active arm, bridge circuit. At zero flow, the bridge circuit is balanced and produces zero output. Forces from the fluid are transferred from the target to the sensing tube producing strain on the sensing tube. The bridge circuit becomes unbalanced producing an output to a microprocessor sending unit. A mass flow computer is connected to the sending unit for visual display.

b. Valve Body: ANSI Class 150; Inline type body with flanged ends - 303/304 stainless steel.

c. Sensing Element: 316 Stainless Steel.

d. Seals: Teflon, Vitron, Buna-N, Grafoil.

e. Sending Unit: Microprocessor design with 24-bit speed and accuracy, 4-20 mA output, programmable cutoff, two programmable open collector output hi/lo set points, RS-232 communications, open collector 0-1000hz square wave output.

Accuracy: 0.02% of rate.
Repeatability: 0.01% of rate.
Power: 16-30vdc, 24vdc@100mA maximum with current loop connected at 4.00maDC.
Temperature: 32-140 degrees F
Enclosure: Explosion proof type watertight housing.

f. Mass Flow Computer: Wall mounted. The mass flow computer indicates mass rate, mass totalization, flow rate, temperature, pressure and density.

Flow: Square wave digital pulse with +/- 0.057% accuracy.
Temperature: 4-wire RTD: 100 ohm platinum to European alpha 3850 curve;
Current loop; 4-20 mA; Accuracy: +/- 0.1% at 25 77 degrees F.
Pressure: Current Loop: 4-20mA; Accuracy: +/-0.1% at 77 degrees F.
Power: 120/240vac + 10%-15%. 50/60 Hz at .2amps.
Temperature: 32-131 degrees F.

2.4.10 Guided Slip Tube Expansion Joints

Internally-externally guided type, injected semiplastic type packing, with service outlets. Joints shall be for minimum working pressure of ASME Class 150. Provide single or double slip tube type as indicated. Provide flanged or buttwelding end connections as indicated.

2.4.11 Flexible Ball Expansion Joints

Provide chromium plated steel balls capable of 360-degree rotation plus 15-degree angular flex movement. Provide pressure molded composition gaskets designed for continuous operation temperature of 525 degrees F. Joints shall be for minimum working pressure of ASME Class 150. Provide flanged or buttwelding end connections as indicated.

2.4.12 Bellows Expansion Joints

Type 304 stainless steel corrugated bellows, reinforced with rings, internal sleeves, and external protective covers. Provide limit stops to limit total movement in both directions. Cold set the joints to compensate for temperature at time of installation. Joints shall withstand 10,000 cycles over a 20 year period. Joints shall be for minimum working pressure of ASME Class 150. Provide single or double bellows expansion joint as indicated. Provide first pipe alignment guide no more than four pipe diameters from the expansion joint; provide second pipe alignment guide no more than 14 pipe diameters from the first guide. Provide flanged or

buttwelding end connections as indicated.

2.5 POLES SUPPORTING ABOVEGROUND PIPING

2.5.1 Concrete Poles

Provide under this section as specified in Section 33 05 16 CONCRETE POLES. Accurately set the top fittings to grade by means of adjusting screws, and grout in place. Provide high-strength grout consisting of one part portland cement and two parts clean, sharp sand with minimal water to make a workable grout. Wet tops of poles before placing the grout. Prevent grout leaks around the bottom of the fittings which streak or disfigure the concrete. Discoloration or disfiguring of concrete will not be permitted.

2.5.2 Guy Wires, Fittings, and Hardware

a. Guy Wires: ASTM A 475, high strength grade, extra galvanized, stranded with seven wires in each strand. Wire shall be a minimum of 3/8 inch diameter. Provide thimbles at each end of guy wire. Prestress guy wires until taut.

b. Anchor Rods and Anchors: Provide thimble-eye, 1.25 inch diameter steel rod with 10 inch diameter screw anchor, hot-dip galvanized.

c. Turnbuckles: Provide open turnbuckles, forged steel body, with jaw and jaw end pulls, 0.375 inch size, hot-dip galvanized.

d. Clamps: Provide hot-dip galvanized forged high carbon steel clamps capable of developing full strength of guy wire, and fitted with galvanized heat-treated bolts. Provide two clamps at each connection of guy wire.

2.5.3 Miscellaneous Metal

ASTM A 36/A 36M, standard mill finished structural shapes, hot-dip galvanized after fabrication.

2.5.4 Fastenings

Provide steel bolts and oversized nuts conforming to ASTM A 307. Galvanize in accordance with ASTM A 153/A 153M. Provide nuts with an approved means for locking to ensure nuts remain tight under severe service, including vibrations. Drive bolts to a tight fit without injury to the threads. Bolts with injured threads will not be permitted. Drill holes 1/16 inch larger than bolts; burning of holes will not be permitted. Tighten bolts to the required torque.

2.6 MANHOLE DRAINERS (EJECTORS)

Provide automatic type drainers to operate on 125 psig steam supply. The drainer shall operate when the water level rises sufficiently in the sump, the float shall rise and open the steam control valve to admit steam to the drainer, which in turn shall pump the water from the sump. When the water level is lowered by the pumping action, the float shall lower and close the steam valve to stop the pumping action until water again gathers in the sump. Provide each drainer with controls to accomplish the above sequence of operation. The automatic float-operated steam valve shall be designed to prevent dead centering under field conditions and to lengthen the life of the valve seat. The valve shall have a high grade, renewable

composition disc and a stainless steel or hard, noncorrosive bronze renewable seat inserted in the valve body. The drainer shall be constructed of corrosion-resistant copper and bronze. Piping from manhole drainers shall be ASTM A 53/A 53M, Weight Class XS (Extra Strong), hot-dip galvanized steel pipe with ASME B16.11 or ASME B16.3, Class 300, hot-dip galvanized threaded fittings. Provide a steam pressure regulating valve assembly for manhole drainers for operation on steam system above 125 psig.

2.7 CONCRETE MANHOLES

Provide under this section as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, except as modified herein. Concrete shall be of 4000 psi minimum 28 day compressive strength, air entrained admixture (3.6 ounces per cubic yard), with water-reducing admixture (22 ounces per cubic yard), reinforced with deformed steel bars. Construct manhole sides by one monolithic pour. Cast-iron steps with nonslip surfaces, and spaced 12 to 16 inches apart on centers shall be firmly embedded in concrete walls for access to bottom of manholes. Provide top of manhole as indicated. Steel grating covers for manholes shall be welded parallel bearing bars, with right angle cross members, zinc coated after fabrication; size as indicated.

2.8 BURIED PIPING UNDER ROADS

Provide new and modify existing buried factory-prefabricated preinsulated steam and condensate piping in accordance with Section 33 63 13 EXTERIOR UNDERGROUND STEAM DISTRIBUTION SYSTEM.

2.8.1 Carrier Piping

2.8.1.1 Steam Piping

Provide steel piping.

2.8.1.2 Condensate Piping

Provide steel piping.

2.8.2 Piping Insulation for Carrier Piping

Products containing asbestos will not be permitted.

2.8.2.1 Insulation for Steam Piping

Nominal Pipe Sizes (Inches)	Calcium Silicate Insulation Cellular Glass Insulation (Inches)	Mineral Fiber Insulation (Inches)
less than 3	3.0	2.5
3 thru 4	3.5	3.0
5 thru 6	4.0	3.5
8 and larger	5.0	4.5

2.8.2.2 Insulation for Steam Condensate Carrier Piping

Nominal Pipe Sizes (Inches)	Calcium Silicate Insulation Cellular Glass Insulation (Inches)	Mineral Fiber Insulation (Inches)
less than 3	2.0	1.5
3 thru 4	2.5	2.0
5 and larger	3.0	2.5

2.8.3 Cathodic Protection

Provide sacrificial anode type cathodic protection system for metal conduits.

2.8.4 Buried Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read CAUTION BURIED STEAM PIPING BELOW OR similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of exterior steam distribution system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1, except as modified herein. Install piping straight and true to bear evenly on supports and sand bedding material. Install valves with stems horizontal or above. Provide flanges or unions at valves, traps, strainers, connections to equipment, and as indicated.

3.1.1 Cleaning of Piping

Keep the interior and ends of new piping and existing piping affected by the Contractor's operations, cleaned of water and foreign matter during installation by using plugs or other approved methods. When work is not in progress, securely close open ends of pipe and fittings to prevent entry of water and foreign matter. Inspect piping before placing into position.

3.1.2 Demolition

Remove materials so as not to damage materials which are to remain. Replace existing work damaged by the Contractor's operations with new work of the same construction.

3.2 PIPING

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for connections. Reducing branch connections in steel piping may be made with forged branch

outlet reducing fittings for branches two or more pipe sizes smaller than mains. Branch outlet fittings shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Stab type connections will not be permitted. Jointing compound for pipe threads shall be Teflon pipe thread paste. Pipe nipples 6 inches long and shorter shall be Schedule 80 steel pipe. Make changes in piping sizes through tapered reducing fittings; bushings will not be permitted. Condensate piping shall include drip, vent, relief, and gage connecting piping.

3.2.1 Fittings and End Connections

For sizes less than one inch provide threaded fittings and end connections. For sizes one to 2 inches provide threaded or socket-welding or buttwelding fittings and end connections; provide threaded connections for threaded valves, traps, strainers, and threaded connections to equipment. For sizes 2.5 inches and larger provide buttwelding fittings and end connections; provide flanged connections for flanged valves, traps, strainers, and flanged connections to equipment.

3.2.2 Welding

ASME B31.1, metallic arc process, including qualification of welders.

3.2.3 Pipe Hangers and Supports

Provide additional hangers and supports for concentrated loads in piping between hangers and supports, such as for valves. Support steel piping as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (Inches)	One and Under	1.5	2	3	4	6	8	10	12
Steel Piping	9	12	13	15	17	21	24	26	30

3.2.4 Buried Piping Under Roads

Installation including field joints, bedding, and initial backfill shall be in accordance with the Approved Brochure.

3.3 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves. Nameplates shall be melamine plastic, 0.125 inch thick, black with white center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be minimum of 0.25 inch high normal block style. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass, and locate where directed near each system. Furnish two copies of each chart and schedule.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspections

Prior to initial operation, inspect piping system for compliance with

drawings, specifications, and manufacturer's submittals.

3.4.2 Piping Tests

Before final acceptance of the work, test each system as in service to demonstrate compliance with contract requirements. Before insulation is applied, hydrostatically test each piping system at not less than 225 psig in accordance with ASME B31.1, with no leakage or reduction in gage pressure for 2 hours. Flush and clean piping before placing in operation. Flush piping at a minimum velocity of 8 fps. Correct defects in work provided by Contractor and repeat tests until work is in compliance with contract requirements. Furnish potable water, electricity, instruments, connecting devices, and personnel for the tests.

3.4.3 Buried Piping Under Roads

Installation including field joints, bedding, and initial backfill shall be in accordance with the Section 33 63 13 EXTERIOR UNDERGROUND STEAM DISTRIBUTION SYSTEM. Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.4.3.1 Conduit Coating

Test conduit coating of buried piping under roads prior to backfill in accordance with the approved brochure.

3.4.3.2 Cathodic Protection

Test cathodic protection of buried piping under roads to prove continuity of electrical connections prior to backfill.

3.5 FIELD PAINTING

After completion of field inspections and tests, clean and paint metal surfaces exposed to the weather and in manholes, including valves, strainers, traps, flow meters, pipe flanges, bolts, nuts, washers, pipe hangers, supports, expansion joints, and miscellaneous metal. Do not paint piping prior to the application of field-applied insulation. Do not paint stainless steel or aluminum jackets. Apply paint to clean dry surfaces. Clean surfaces to remove dust, dirt, rust, oil, and grease. Provide surfaces with two coats of enamel paint applied to a total minimum dry film thickness of 2 mils. Apply the second coat of paint after the preceding coat is thoroughly dry. Color of finish coat shall be aluminum or light gray. Paint shall be rated for use on hot metal surfaces up to 450 degrees F and for use on surfaces exposed to the weather.

3.6 CONNECTIONS TO EXISTING SYSTEMS

Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required. Obtain approval before interrupting service. Provide materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required.

-- End of Section --

SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS O5.1	(2002; Supple A 2003; Supple B 2003; Supple C 2004) Specifications and Dimensions (for Wood Poles)

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM B 117	(2007) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B 496	(2004) Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 478	(2007) Standard Specification for Precast Reinforced Concrete Manhole Sections

ASTM C 478M	(2007) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D 1654	(2005) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2472	(2000; R 2006) Standard Specification for Sulphur Hexafluoride
ASTM D 4059	(2000; R 2005e1) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM D 923	(2007) Standard Practice for Sampling Electrical Insulating Liquids

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(2005) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; Errata 2007) National Electrical Safety Code
IEEE C37.1	(1994) Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control
IEEE C37.121	(1989; R 2006) American National Standard for Switchgear Unit Substations Requirements
IEEE C37.13	(1990; R 1995) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	(2000) Recommendations for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors, - Preferred Ratings, Related Requirements, and Application
IEEE C37.2	(1996; R 2001) Electrical Power System Device Function Numbers and Contact Designations
IEEE C37.20.1	(2002; Amendment A 2005; Amendment B 2006) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.20.2	(1999) Metal-Clad Switchgear
IEEE C37.20.3	(2001) Metal-Enclosed Interrupter Switchgear
IEEE C37.23	(2003) Guide for Metal-Enclosed Bus and

	Calculating Losses in Isolated-Phase Bus
IEEE C37.30	(1997) Requirements for High-Voltage Switches
IEEE C37.34	(1994) Test Code for High-Voltage Air Switches
IEEE C37.41	(2000) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C37.46	(2000) For High Voltage Expulsion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches
IEEE C37.63	(2005) Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers for AC Systems
IEEE C37.90.1	(2002) Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.12.00	(2006) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.21	(1992) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; High Voltage, 34 500 Grd Y/199200 Volts and Below; Low Voltage, 2400/120 Volts; 167 kVAand Smaller
IEEE C57.12.26	(1992; Addenda 1993) Transformers - Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High Voltage, (34 500 Grd Y/19 920 and Below; 2500 kVA and Smaller)
IEEE C57.12.28	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.13	(1993; R 2003) Standard Requirements for Instrument Transformers
IEEE C57.98	(1993; R 1999) Guide for Transformer Impulse Tests
IEEE C62.11	(2005) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
IEEE Std 242	(2001) Recommended Practice for Protection

	and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE Std 386	(2006) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 399	(1997) Recommended Practice for Power Systems Analysis - Brown Book
IEEE Std 404	(2006) Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V Through 500 000 V
IEEE Std 48	(1996; R 2003) Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60255-21-3	(1993) Electrical Relays - Part 21: Vibration, Shock, Bump And Seismic Tests On Measuring Relays And Protection Equipment - Section 3: Seismic Tests

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA BU 1.1	(2005) General Instructions for Proper Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less
NEMA C119.1	(2006) Sealed Insulated Underground Connector Systems Rated 600 Volts
NEMA C12.10	(2004) Physical Aspects of Watthour Meters
NEMA C12.11	(1987; R 2002) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
NEMA C12.4	(1984; R 2002) Mechanical Demand Registers
NEMA C29.1	(1988; R 2002) Test Methods for Electrical Power Insulators
NEMA C37.50	(1989; R 2000) Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures

NEMA C80.1	(2005) Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA FB 1	(2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA LA 1	(1992; R 1999) Standard for Surge Arresters
NEMA PB 1	(2006) Standard for Panelboards
NEMA PB 2	(2006) Deadfront Distribution Switchboards
NEMA SG 2	(1993) Standard for High-Voltage Fuses
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride PVC Plastic Utilities Duct for Underground Installations

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2007) National Electrical Code - 2008 Edition

UNDERWRITERS LABORATORIES (UL)

UL 1242	(2006; Rev thru Jul 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1684	(2000; Rev thru Aug 2004) Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
UL 198M	(2003; Rev thru Oct 2007) Mine-Duty Fuses
UL 467	(2007) Standard for Grounding and Bonding Equipment
UL 486A-486B	(2003; Rev thru Aug 2006) Standard for Wire Connectors
UL 489	(2002; Rev thru Jun 2006) Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 510	(2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(2004; Rev thru Aug 2007) Standard for Metallic Outlet Boxes
UL 6	(2007) Standard for Electrical Rigid Metal Conduit-Steel
UL 651	(2005; Rev thru May 2007) Standard for

	Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 854	(2004; Rev thru Oct 2007) Service-Entrance Cables
UL 857	(2001; Rev thru Nov 2002) Busways

1.2 SYSTEM DESCRIPTION

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall be as indicated.

a. Fungus Control as indicated

b. Altitude as indicated feet.

c. Ambient Temperature as indicated degrees F.

d. Frequency as indicated

e. Ventilation as indicated

f. Seismic Parameters as indicated

g. Humidity Control as indicated

h. Corrosive Areas as indicated

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings
As-Built Drawings

Drawings, as specified.

SD-03 Product Data

Fault Current Analysis
Protective Device
Coordination Study

The study with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government will not be responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Nameplates

Catalog cuts, brochures, circulars, specifications, product

data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material and Equipment

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Requirements

As a minimum, installation procedures for transformers, substations, switchgear, and splices. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Operating Tests

Six copies of the tests report in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

Cable Installation

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Material and Equipment

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Joints

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Installation Engineer

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Sixcopies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers. Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 QUALITY ASSURANCE

1.4.1 Detail Drawings

Submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

1). Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

2). Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

3). Detail drawings shall as a minimum depict the installation of the following items:

(a). Medium-voltage cables and accessories including cable installation plan.

(b). Transformers.

(c). Substations.

(d). Switchgear.

(e). Pad-mounted loadbreak switches.

(f). Busways.

(g). Surge arresters.

1.4.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. Correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Store oil filled transformers and switches in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS O5.1.

Handle wood poles in accordance with ATIS O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.6 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Provide material and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486A-486B shall be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be as indicated.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of 15 kV, as indicated.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding.

2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of AEIC CS8. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape

shield for each phase. The shield tape shall be sized to meet IEEE C2 requirements for a ground fault availability as indicated.

2.4.1.6 Neutrals

Neutral conductors of shall be copper. employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable. Concentric neutrals conductors shall have a combined ampacity equal to the phase conductor ampacity rating.

2.4.1.7 Jackets

Cables shall be provided with a polyethylene jacket. Direct buried cables shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.4 Direct Buried

Single and multi-conductor cables shall of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70. .

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a

resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to NEMA C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.3 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.3.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level.

2.5.3.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 12-1/2 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application. Communication lines run elsewhere may be direct-burial, thick-wall type.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and NEMA C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Bituminized Fiber Duct

UL 1684 for Type I (Thinwall), Type II (Thickwall).

2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 & 8 Type EB.

2.6.2.3 Direct Burial

UL 651 as indicated, or NEMA TC 6 & 8 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48/A 48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 POLES AND HARDWARE

Poles and hardware shall be in accordance with Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

2.9 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation

level.

2.9.1 Secondary Unit Substation

Secondary unit substations shall comply with IEEE C37.121 and shall be of the radial type with an outgoing section mounted integrally on the transformer. Substations shall be subassembled and coordinated by one manufacturer and shall be shipped in complete sections ready for connection at the site. Complete sections shall include incoming, transformer, and outgoing sections and, where practicable, shall be shipped as one unit.

2.9.1.1 Incoming Section

Metal-enclosed interrupter switchgear consisting of fused, vacuum-insulated, SF6-insulated, interrupters in series with automatic, visible blade disconnects shall be provided for protection of incoming circuits. SF6 gas shall conform to ASTM D 2472. Metal-enclosed interrupter switchgear shall comply with IEEE C37.30 for load-interrupter switches, NEMA SG 2 for power fuses, and shall be of the outdoor no-aisle type that meets or exceeds the requirements of applicable publications listed. Switch construction shall be of the manually-operated, "OPEN-CLOSED," vacuum-insulated, SF6-insulated, load interrupter type equipped with a stored energy operator for quick-make quick-break to make operating speeds independent of manual switch operations. Where indicated, suitable bus or lug connections shall be provided to mount field-installed, slip-on, medium-voltage cable terminations for cable entering via conduit from below and a flanged throat suitable for direct connection to the associated transformer and a bus throat suitable for connection to the associated metal-enclosed bus. Surge protection shall be provided in accordance with paragraph SURGE ARRESTERS. Switches shall be of the 2-position type, open-closed. Duplex switches shall be of the dual compartment type with 2 interrupter switches.

a. Ratings. Fuse continuous current ratings shall be as indicated for the transformer for an incoming line unit and for the line tie unit. Unless otherwise indicated, fuses shall be of the current limiting type. Switch ratings at 60 Hz shall be:

Nominal voltage.....As Indicated.

Rated maximum voltage.....As Indicated.

Maximum symmetrical interrupting capacity.....As Indicated.

Maximum asymmetrical interrupting capacity.....As Indicated.

3-Second short time current carrying capacity.....As Indicated.

Rated continuous current.....As Indicated.

BIL.....As Indicated.

b. Basic Requirements. The electrical devices listed below shall be rated for the application and voltage and current indicated. Unless otherwise noted, manufacturer's standard devices shall be provided and shall include the following:

(1) A switch-operating handle with provisions for locking in either the open or closed position.

(2) A switch mechanical position indicator.

(3) A heater continuously energized to prevent condensation over an ambient temperature range of minus 20 degrees F to 40 degrees F at 90% relative humidity and wired in series with a cabinet door-actuated switch, so the heater is de-energized when doors are open. High-temperature thermal protection shall be included.

(4) One-pole or 2-pole thermal-magnetic, molded-case circuit breakers suitable for the operating voltage for heater circuits.

(5) Safety devices as necessary to ensure that the load interrupter switch is in the open position whenever unit doors are in the open position.

(6) A key interlock if indicated.

(7) An interface terminal block wired for required exterior connections.

2.9.1.2 Transformer Section

Transformers shall have two separate windings per phase and shall be of the less-flammable, liquid-insulated type with high molecular-weight hydrocarbon liquid. Transformers shall be suitable for outdoor use. Liquid-insulated transformers shall comply with IEEE C57.12.00, and shall have two 2-1/2 percent full capacity taps above and two 2-1/2 percent full capacity taps below rated voltage. Transformers shall be of the sealed tank type construction with welded-on cover. High-voltage terminals shall be provided in an air terminal chamber for incoming as shown on the drawings. Low-voltage terminals shall be provided in an air terminal chamber for incoming as shown on the drawings. Low-voltage terminals shall be as shown on the drawings when facing the front, accessory side of the transformer. Transformers shall be equipped with forced air cooling equipment to give kVA capacity as indicated. The equipment shall include the necessary fans, conduit and wiring, motor starters, and top liquid thermometer for fan control. Provision shall be made for the future addition of forced air cooling equipment to give _____ kVA capacity. The transformer bushings, leads, and other components shall be designed to carry the increased load. A top liquid thermometer for control of future fans shall be furnished. Provision for future mounting of fans, conduit, and terminal box shall be provided. Transformer accessories and ratings at 60 Hz shall be as follows:

1. Three-phase capacity, self-cooled.....As indicated.

2. Three-phase capacity, (future) forced-cooled.....As indicated.

3. Impedance.....As indicated.

4. Temperature rise.....As indicated.

5. High-voltage winding.....As indicated.

6. High-voltage winding connection.....As indicated.

7. Low-voltage winding.....As indicated.

8. Low-voltage winding connection.....As indicated.

Accessories:

1. drain and filter connection.

2. filling and top filter press connection.

3. pressure-vacuum gauge.

4. dial type thermometer with alarm contacts.

5. magnetic liquid level indicator with high and low level alarm contacts.

6. pressure relief device with alarm contacts.

7. ground connection pad.

8. provision for jacking, lifting, and towing.

9. diagram and rating nameplate.

2.9.1.3 Integral Outgoing Section

Integral outgoing section shall be as indicated. Each circuit breaker and auxiliary compartment shall have a suitable metal or laminated plastic nameplate with white cut letters at least 1/4 inch high on contrasting backgrounds as indicated.

a. Busway Throat Compartment Type: Outgoing section shall consist of an enclosure containing metering devices on the main secondary circuit and connections from transformer terminals to suitable busway throats provided for connections to busway installations entering from above as shown. Connection to porcelain bushings shall be made with flexible jumpers.

b. Dead-Front Distribution Panelboard/Switchboard Type: Outgoing section shall be of the panelboard/switchboard type mounted integrally with the transformer and shall consist of metering devices and main and branch circuit breakers mounted in panelboard/switchboard enclosures. Panelboards shall comply with NEMA PB 1. Switchboards shall comply with NEMA PB 2. Molded-case and low-voltage power circuit breakers shall comply with paragraph METERING AND PROTECTIVE DEVICES. Plug-in type circuit breakers are not acceptable. Directories to indicate loads served by each circuit shall be typed and mounted in holders provided on panelboard doors behind protective coverings.

c. Metal-Enclosed Switchgear Type: Low-voltage power circuit breakers shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES.

d. Metering: The main secondary bus of each outgoing section assembly shall include a watthour demand meter with the necessary instrument transformers, and VT and CT test blocks. Metering shall be as specified in paragraph METERING AND PROTECTIVE DEVICES.

e. Ground Fault Protection: Ground fault protection shall be provided utilizing sensors of the zero-sequence type or by the residual

connection of phase and neutral current sensors. Ground fault settings shall be as shown, as determined by the coordination study.

2.9.1.4 Nonintegral (Cable Compartment) Outgoing Section

A cable compartment shall be provided on the transformer for cable connections as shown. Clamp type terminations for cables entering from above shall be provided for connection to the transformer bushings. Clamp type cable terminations, suitable for copper conductors, shall be provided for the circuit sizes shown.

2.9.2 Pad-Mounted Transformers

Pad-mounted transformers shall comply with IEEE C57.12.26 and shall be of the loop feed type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of IEEE C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.9.2.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, oil-immersed, current-limiting, bayonet-type fuses, oil-immersed, bayonet-type, overload fuse in series with a partial range current-limiting fuse, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on the same bushing as the primary cable by means of a loadbreak, feed-through bushing insert, a second set of high voltage bushings.

2.9.2.2 Load-Break Switch

a. Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 ampere, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

b. Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch

handle in the high-voltage compartment. Operation of switches shall be as follows:

ARRANGEMENT #	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION LINE A SW OPEN	LINE A SW CLOSE	LINE B SW OPEN	LINE B SW CLOSE	XFMR SW OPEN	XFMR SW CLOSE
1	Line A connected to Line B and both lines connected to transformer		X		X		X
2	Transformer connected to Line A only		X	X			X
3	Transformer connected to Line B only	X			X		X
4	Transformer open and loop closed		X		X	X	
5	Transformer open and loop open	X		X		X	

2.9.2.3 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00 and IEEE C57.12.21 and shall be of the less-flammable, liquid-insulated type with high molecular-weight hydrocarbon. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below, below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

a. Three-phase capacity.....As indicated.

b. Impedance.....As indicated.

c. Temperature Rise.....As indicated.

d. High-voltage winding.....As indicated.

e. High-voltage winding connections.....As indicated.

f. Low-voltage winding.....As indicated.

g. Low-voltage winding connections.....As indicated.

2.9.2.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.9.2.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.9.3 Busways

Busways shall comply with NEMA BU 1.1 and UL 857 and shall be of the voltage, phase, and continuous current ratings indicated. Neutrals shall be full size, half size. Busways shall have short-circuit ratings not less than the maximum short-circuit currents of associated transformers, assuming primary sources of infinite capacity. Busways shall be feeder-low-impedance type and of outdoor or indoor service construction as suitable to the location. Busways shall be complete with elbows, fittings, flanges, end-closures, tees, crosses, cable-tap boxes, accessories, and other devices required for the indicated installation, and shall be coordinated for connection to the indicated equipment. For wet/damp locations, bus duct shall be heated, nonventilated enclosure, nonsegregated phase type in accordance with IEEE C37.23. Detail drawings for busway supports and bracing shall be submitted in accordance with the detail drawings portion of paragraph SUBMITTALS and shall indicate that busways are adequately supported for the seismic forces specified in paragraph GENERAL REQUIREMENTS (sub-paragraph Service Conditions).

2.9.4 Pad-Mounted, Metal-Enclosed, Switchgear

The switchgear shall be configured as indicated with incoming compartments for loop-feed arrangement, one incoming compartment for radial-feed, equipped with air-insulated, load-interrupter switches, SF6-insulated, load-interrupter switches, as indicated. The outgoing compartments shall be provided with fused disconnects non-reclosing vacuum-type interrupters or circuit breakers, as indicated.

2.9.4.1 Ratings at 60 Hz shall be:

a. Nominal voltage (kV).....As indicated.

b. Rated maximum voltage (kV).....As indicated.

c. Rated continuous current (A).....As indicated.

d. Maximum symmetrical interrupting capacity (kA).....As indicated.

e. Maximum asymmetrical interrupting capacity (kA).....As indicated.

f. Three-second short-time current-carrying capacity (kA).As indicated.

g. BIL (kV).....As indicated.

2.9.4.2 Operators, Devices, and Controls

Operators and controls shall be provided for the switchgear as follows:

a. Switches shall be provided with a manual, handle-type operator or a push-button mechanical spring tripping mechanism, utilizing a stored-energy (spring-driven) mechanism to simultaneously open or close all phases. The switchgear shall be configured so that the switch actuator is padlockable, but may be accessed without opening the switch compartment doors.

b. Fused disconnects shall be hook-stick operated.

c. Switches shall be provided with an automatic switch operator configured for local and remote opening and closing. An actuator charging motor shall be provide which operates as indicated. Switches shall be provided with remote telemetry units (RTUs) for remote operation and integration with supervisory, control, and data acquisition systems. Systems, components, and equipment shall conform to the requirements and recommendations of IEEE C37.1.

d. Vacuum type interrupters shall be provided with an electronic controller for trip initiation. Manual trip initiation shall be provided by a push button or switch. Automatic trip shall be initiated by detection of excessive current. The electronic controller shall provide trip current selection capability according to present time-current response curves, as indicated. Each interrupter shall be provided with a 3 phase, gang-operated handle mechanism for trip and reset.

2.9.4.3 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of IEEE C57.12.28 and IEEE C37.20.3, Category A.

2.9.5 Pad-Mounted Sectionalizers

Pad-mounted, sectionalizing switches shall conform to the requirements of IEEE C37.63. The switchgear shall be configured as indicated with incoming compartments for loop-feed arrangement equipped with air-insulated, load-interrupter switches SF6-insulated load-interrupter switches, as indicated. The outgoing compartments shall be provided with non-reclosing sectionalizers.

2.9.5.1 Ratings

Ratings at 60 Hz shall be:

a. Nominal voltage (kV).....As indicated.

b. Rated maximum voltage (kV).....As indicated.

c. Rated continuous current (A).....As indicated.

d. Three-second short-time current-carrying capacity (kA) .....As indicated.

e. BIL (kV).....As indicated.

2.9.5.2 Enclosures

Switchgear enclosures shall be of freestanding, self-supporting construction provided with separate incoming and outgoing compartments configured for bottom cable entry. Enclosures shall be of deadfront construction, provided with a hinged door for access to each compartment, and conform to the requirements of IEEE C57.12.28 and IEEE C37.20.3, Category A.

2.9.6 Cable Terminating Cabinets

Cable terminating cabinets shall be hook-stick operable, deadfront construction conforming to the requirements of IEEE C37.20.3, Category A. Cabinets shall be provided with with 200 A. loadbreak junctions and elbow-type separable loadbreak connectors, cable parking stands, and grounding lugs. The cable terminating equipments shall conform to IEEE Std 386.

Ratings at 60 Hz shall be:

a. Nominal voltage (kV).....As indicated.

b. Rated maximum voltage (kV).....As indicated.

c. Rated continuous current (A).....As indicated.

d. Three-second short-time current-carrying capacity (kA).....As indicated.

e. BIL (kV).....As indicated.

2.10 METERING AND PROTECTIVE DEVICES

2.10.1 Circuit Breakers, Low-Voltage

2.10.1.1 Low-Voltage Power Circuit Breakers

a. Construction. Low-voltage power circuit breakers shall conform to IEEE C37.13 and IEEE C37.16, and shall be three-pole, single-throw, stored energy, manually, electrically operated, with drawout mounting. Solid-state trip elements which require no external power connections shall be provided. Circuit breakers shall have an open/close contact indicator, primary disconnect devices, and a mechanical interlock to prevent making or breaking contact of primary disconnections when the circuit breaker is closed. Control voltage shall be 24, 48, 125 V dc, 120 V ac, as indicated. The circuit breaker enclosure shall be suitable for its intended location.

b. Ratings. Voltage ratings shall be not less than the applicable circuit voltage. Circuit breakers shall be rated for 100 percent continuous duty and shall have trip current ratings and frame sizes as shown. Nominal voltage ratings, maximum continuous-current ratings,

and maximum short-circuit interrupting ratings shall be in accordance with IEEE C37.16. Tripping features shall be as follows:

1. Long-time current pick-up, adjustable from 50 percent to 100 percent of sensor current rating.

2. Adjustable long-time delay.

3. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.

4. Adjustable short-time delay.

5. Short-time I2t switch.

6. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.

7. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap shall not be permitted.

8. Adjustable ground-fault delay.

9. Ground-fault I2t switch.

10. Overload and short-circuit and ground-fault trip indicators shall be provided.

2.10.1.2 Molded-Case Circuit Breakers

NEMA AB 1 and UL 489.

2.10.2 Fuses, Medium-Voltage, Including Current-Limiting

2.10.2.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.10.2.2 Ratings

Expulsion-type Current-limiting power fuses shall have ratings in accordance with IEEE C37.46 and as follows:

a. Nominal voltage.....As indicated.

b. Rated maximum voltage.....As indicated.

c. Maximum symmetrical interrupting capacity.....As indicated.

d. Rated continuous current.....As indicated.

e. BIL.....As indicated.

2.10.2.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to IEEE C37.46.

2.10.2.4 C-Rated, Current-Limiting Power Fuses

C-rated, current-limiting power fuses shall open in 1000 seconds at currents between 170 and 240 percent of the C rating.

2.10.3 Fuses, Low-Voltage, Including Current-Limiting

Low-voltage fuses shall conform to NEMA FU 1. Time delay and nontime delay options shall be as specified. Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilizes fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination.

2.10.3.1 Cartridge Fuses

As specified.

a. Class G, J, L, CC fuses shall conform to UL 198M.

b. Class K fuses shall conform to UL 198M.

c. Class R fuses shall conform to UL 198M.

d. Class T fuses shall conform to UL 198M.

2.10.3.2 Transformer Circuit Fuses

Transformer circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

2.10.4 Instrument Transformers

2.10.4.1 General

Instrument transformers shall comply with NEMA C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.10.4.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall not be less than 1.0, 1.2, 1.5, 2.0, 3.0, 4.0. Other thermal and mechanical ratings of current transformers and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accident open-circuiting of the transformers while energized. Each terminal of each

current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.10.4.3 Current Transformers for Power Transformers

As indicated.

2.10.4.4 Current Transformers for Metal-Enclosed Switchgear

As indicated.

2.10.4.5 Current Transformers for Kwh and Demand Metering (Low-Voltage)

As indicated.

2.10.4.6 Voltage Transformers

As indicated.

2.10.5 Watthour Meters

Watthour meters shall conform to NEMA C12.10, except numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the socket mounted outdoor, indoor type having a 30 minute, cumulative form, demand register meeting NEMA C12.4 and provided with not less than 2-1/2 stators. Watthour demand meters shall have factory-installed electronic pulse initiators. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures, shall be capable of operating up to speeds of 500 pulses per minute with no false pulses, and shall require no field adjustments. Initiators shall be calibrated for a pulse rate output of 1 pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.10.6 Protective Relaying

As indicated.

2.10.6.1 Ratings

Relays shall be the manufacturer's standard items of equipment with appropriate ranges for time dial, tap, and other settings. Relay device numbers shall correspond to the function names and descriptions of IEEE C37.2.

2.11 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, and IEEE C62.11 and shall be provided where indicated. Arresters shall be station, intermediate, distribution class, rated as shown. Arresters for use at elevations in excess of 6000 feet above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the valve or metal-oxide varistor type.

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used.

2.12.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.13 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03 20 01.00 10 CONCRETE REINFORCEMENT.

2.14 PADLOCKS

Padlocks shall comply with Section 08 71 00 DOOR HARDWARE.

2.15 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.15.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.15.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.15.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

2.16 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50, 2 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 50, 2 ppm shall be replaced.

2.17 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard routine tests in accordance with IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE C37.34 and IEEE C37.41.

d. Protective Relays: Seismic tests in accordance with IEC 60255-21-3. Surge withstand tests in accordance with IEEE C37.90.1.

e. Relaying Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

f. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

h. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE C37.20.1, IEEE C37.20.2, and IEEE C37.20.3.

i. Electrical Power Insulators: Manufacturer's standard tests in accordance with NEMA C29.1.

2.18 FENCING

Fencing shall conform to the requirements of Section 32 31 13 CHAIN LINK FENCES AND GATES.

2.19 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and

system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. Provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.19.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin: as indicated.

2.19.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. Utilize the fault current availability indicated as a basis for fault current studies.

2.19.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.19.4 Fault Current Analysis

2.19.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.19.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.19.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectively has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and any relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on

log-log graph paper.

2.19.6 Study Report

a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. The report shall document utility data including system voltages, fault MVA, system X/R ratio, time-current characteristics curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.

d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.

e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed aerially shall conform to the requirements of Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.2.2 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. Furnish

certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.3 CABLE AND BUSWAY INSTALLATION

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. And then prepare a checklist of significant requirements perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.3.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.3.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.3.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.3.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.3.1.4 Cable Installation

Provide a cable feeding truck and a cable pulling winch as required. Provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. Do not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

3.3.1.5 Cable Installation Plan

Submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.3.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Cable joints in medium-voltage cables shall be made in above ground junction boxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.3.3 Direct-Burial

Medium-voltage cables Cables shall be buried directly in the earth as indicated. Minimum cover from the top of a cable to finished grade shall be 36 inches but not less than the depth of the frost line, _____.

3.3.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil.

3.3.3.2 Cable Burial

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as

required to pull cables through conduits under paving or railroad tracks. Where cables cross, a separation of at least 3 inches shall be provided, unless each cable circuit is protected by a nonmetallic conduit sleeve at the crossing. Where single-conductor cable is installed, all 3 phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than 12 times the diameter of the cable. In no case shall cables be left under longitudinal tension. The first 6 inch layer of backfill shall be of sand. Machine compaction shall not be used within 6 inches of the cable.

3.3.3.3 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

3.3.3.4 Cable Joints or Splices

Cable joints or splices for Medium-Voltage Cable Joints or Low-Voltage Cable Splices in direct-burial cables are not permitted in runs of 1000 feet or less, nor at intervals of less than 1000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in above-ground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

3.3.3.5 Cable Markers

Markers shall be located as indicated. In addition to markers, a 5 mil, brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of trenches.

3.3.4 Insect and Rodent Damage

Animal guards shall be installed as shown.

3.3.5 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.3.6 Busway Installation

Busways penetrating walls shall have wall flanges installed on both surfaces of walls. Wall openings shall be approximately 1/4 inch larger than the busway on each of the 4 busway sides, and openings shall be sealed with a suitable compound. Fire barriers shall be provided when penetrating fire rated walls. Fire barriers shall have a rating equal to the fire wall rating. A weather barrier shall be used when a busway penetrates an exterior wall. Busways shall be supported at intervals not exceeding 10 feet and shall be braced to prevent lateral movement.

3.4 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.5 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing.

3.5.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.5.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.6 DUCT LINES

3.6.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.6.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

3.6.4 Nonencased Direct-Burial

Top of duct lines shall be not less than 36 inches below finished grade and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3 inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3 to 6 inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.6.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.6.5.1 Bituminized-Fiber Ducts

Bituminized-fiber ducts shall be used to interface with existing bituminized-fiber duct as shown. To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below 0 degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below 32 degrees F.

3.6.5.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.6.6 Duct Line Markers

Duct line markers shall be provided as indicated. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.7 MANHOLES, HANDHOLES, AND PULLBOXES

3.7.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving.

The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may, as an option, utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.7.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.7.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks. Cables for the telephone and communication systems will be installed by others.

3.7.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.7.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.7.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes.

Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.8 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose. Three-phase transformers shall be installed with _____ phase sequence. Primary taps shall be set at _____.

3.8.1 Concrete Pads

3.8.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.8.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and comform to the requirements of Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03 20 01.00 10 CONCRETE REINFORCEMENT.

3.8.1.3 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.8.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed alike, as directed by the Contracting Officer.

3.8.3 Fencing

Fencing shall conform to the requirement of and be installed in accordance with Section 32 31 13 CHAIN LINK FENCES AND GATES. Fences shall provide working clearances for operation and maintenance in accordance with IEEE C2. The entire space between fences and concrete pads shall be excavated to a minimum depth of 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 1/2 to 1-1/2 inches graded size up to finished gradelines. Space between fences and concrete pads shall be excavated to a minimum depth of 4 inches below finished gradelines, shall be graded to reasonably level surfaces, and filled with well-compacted clean coarse gravel or crushed stone of 1/2 to 1-1/2 inches graded size up to finished gradelines.

3.9 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 10 feet apart and with 1 strap not more than 12 inches from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Capnut potheads shall be used to terminate medium-voltage multiple-conductor cable. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard. Pole installation shall be in accordance with Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

3.10 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.11 GROUNDING

A ground system consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer, a switchgear ground bus, and a unit substation to the ground system. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.11.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods

shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.

b. Ground mat - A ground mat shall be installed as shown consisting of bare copper conductors installed 24 inches, plus or minus 3 inches, below the finished top of soil grade. Mat conductors shall be bonded to all rod electrodes, electrolytic electrodes, and to all other intersecting mat conductors. Mat conductors shall be sized as shown on the drawings.

c. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 24 inches, plus or minus 3 inches below finished top of soil grade. Ground ring conductors shall be sized as shown.

d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided as indicated to achieve the specified ground resistance. The additional electrodes will be up to three, 10 feet rods spaced a minimum of 10 feet apart a single extension-type rod, 3/4 inch diameter, up to 30 feet long, driven perpendicular to grade. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.11.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.11.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.11.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.11.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No.

4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.11.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.11.7 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet.

3.12 FIELD TESTING

3.12.1 General

Field testing shall be performed in the presence of the Contracting Officer. Notify the Contracting Officer _____ days prior to conducting tests. Furnish all materials, labor, and equipment necessary to conduct field tests. Perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. Maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.12.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

3.12.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Single rod electrode - 25 ohms.

b. Multiple rod electrodes - ohms as indicated.

c. Ground mat - ohms as indicated.

d. Ground ring - ohms as indicated.

3.12.4 Ground-Mat Connection Inspection

All below-grade ground-mat connections will be visually inspected by the Contracting Officer before backfilling. Notify the Contracting Officer _____ hours before the site is ready for inspection.

3.12.5 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC C8 or AEIC CS8 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.12.6 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.12.7 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer

manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.12.8 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers. Pass-fail criteria shall be in accordance with the transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

3.12.9 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers. Pass-fail criteria shall be in accordance with the circuit breaker manufacturer's specifications.

a. Insulation resistance test phase-to-phase.

b. Insulation resistance test phase-to-ground.

c. Closed breaker contact resistance test.

d. Power factor test.

e. High-potential test.

f. Manual and electrical operation of the breaker.

3.12.10 Power Circuit Breaker Tests

The following power circuit breakers shall be tested in accordance with NEMA C37.50.

3.12.11 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE C57.13.

3.12.12 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years

of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

a. Secondary unit substation

b. Pad-mounted transformers

c. Panelboards

d. Switchboards

e. Metal-enclosed switchgear

f. Busways

g. Switches

3.12.13 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted including the following:

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

3.13 MANUFACTURER'S FIELD SERVICE

3.13.1 Onsite Training

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

3.13.2 Installation Engineer

After delivery of the equipment, furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.14 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 33 71 01

OVERHEAD TRANSMISSION AND DISTRIBUTION

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS O5.1	(2002) Wood Products - Specifications and Dimensions

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153/A 153M	(2001; Rev. A) Zinc Coating (Hot-Dip) on Iron and Steel Hardware - AASHTO No.: M232
ASTM A 475	(1998) Zinc-Coated Steel Wire Strand
ASTM B 1	(2001) Hard-Drawn Copper Wire
ASTM B 2	(2000) Medium-Hard-Drawn Copper Wire
ASTM B 3	(2001) Soft or Annealed Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 231/B 231M	(1999) Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 397	(1985; R 1999) Concentric-Lay-Stranded Aluminum-Alloy 5005-H19 Conductors
ASTM B 399/B 399M	(1999) Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors
ASTM D 117	(2002) Electrical Insulating Oils of Petroleum Origin
ASTM D 3487	(2000) Mineral Insulating Oil Used in Electrical Apparatus

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2000) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C4	(1995) Poles - Preservative Treatment by Pressure Processes

AWPA C25	(1995) Sawn Crossarms, - Preservative Treatment by Pressure Processes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code (ANSI/IEEE)
IEEE C12.7	(1993) Watthour Meter Sockets (ANSI/IEEE)
IEEE C37.30	(1997) High-Voltage Switches (ANSI/IEEE)
IEEE C37.60	(1981; R 1992) Overhead, Pad Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems (ANSI/IEEE)
IEEE C37.63	(1997) Overhead, Pad Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers for AC Systems (ANSI/IEEE)
IEEE C57.12.00	(2000) Liquid-Immersed Distribution, Power, and Regulating Transformers (ANSI/IEEE)
IEEE C57.12.90	(1999) Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers (ANSI/IEEE)
IEEE C57.13	(1993) Instrument Transformers (ANSI/IEEE)
IEEE C62.11	(1999) Metal-Oxide Surge Arresters for AC Power Circuits (= 1 kV) (ANSI/IEEE)
IEEE C135.22	(1988) Zinc-Coated Ferrous Pole-Top Insulator Pins with Lead Threads for Overhead Line Construction

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C12.1	(2001) Electric Meters; Code for Electricity Metering (ANSI Approved)
NEMA C12.10	(1997) Electromechanical Watthour Meters (ANSI Approved)
NEMA C29.2	(1992; R 1999) Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type (ANSI Approved)
NEMA C29.3	(1986; R 2002) Wet Process Porcelain Insulators - Spool Type
NEMA C29.4	(1989; R 2002) Wet-Process Porcelain Insulators - Strain Type
NEMA C29.5	(1984; R 2002) Wet-Process Porcelain Insulators - Low- and Medium-Voltage Types

NEMA C29.7	(1996) Wet Process - Porcelain Insulators - High-Voltage Line-Post Type
NEMA C37.32	(2002) High-Voltage Air Switches, Bus Supports, and Switch Accessories - Schedules of Preferred Ratings, Manufacturing Specifications, and Application Guide
NEMA C37.42	(1996) High Voltage Expulsion Type Distribution Class Fuses, Cutouts, Fuse Disconnecting Switches and Fuse Links
NEMA C57.12.20	(1997) Transformers - Overhead Type Distribution Transformers, 500 kVA and Smaller: High-Voltage, 34500 Volts and Below; Low-Voltage, 7970/13800Y Volts and Below (ANSI Approved)
NEMA C57.12.28	(1999) Pad-Mounted Equipment - Enclosure Integrity (ANSI Approved)
NEMA WC 70	(1999) Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
NEMA WC 71	(1999) Nonshielded Power Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy ICEA S-96-659-1999

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1999) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 202-1	(2001; Supp. 2002) List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers
RUS 1728F-700	(1993) Wood Poles, Stubs, and Anchor Logs

UNDERWRITERS LABORATORIES (UL)

UL 6	(2000; Bul. 2001, 2002) Rigid Metal Conduit - Steel
UL 510	(1994; R 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods" and Section 26 08 00, "Apparatus Inspection and Testing" apply to this section with additions and modifications specified herein.

1.3 OVERHEAD SERVICE

Terminate overhead service conductors into buildings at service entrance fittings or weatherhead outside building. Installation and connection of service entrance equipment to overhead service conductor is included in Section 26 20 00, "Interior Distribution System." Nearby support bracket for overhead wires shall be not less than 10 feet above finished grade at building.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Public Works (Code 404), Building 1005 Michael Road, Camp Lejeune, North Carolina will review and approve transformer submittals. As an exception to this paragraph, transformers manufactured by ABB in Athens, GA; by Cooper Power Systems in Waukesha, WI or Nacogdoches, TX; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, the following shall be submitted.

a. A certification, from the manufacturer, that the technical requirements of this specification shall be met.

b. Routine and other tests (paragraph entitled "Routine and Other Tests, shall be conducted by the manufacturer and may, will be witnessed by the Government (paragraph entitled "Source Quality Control"). Provide certified copies of the tests.

c. Provide field test reports (paragraph entitled "Field Quality Control").

SD-03 Product Data

Conductors

Insulators

Wood Poles

Pole top switch

Recloser

Sectionalizer

Cutouts

Transformer

Metering equipment

Meters

Surge arresters

Guy strand

Anchors

SD-06 Test Reports

Field Test Plan

Field Quality Control

Ground resistance test reports

Submit report of the acceptance test results as specified by paragraph entitled "Field Quality Control"

SD-07 Certificates

Wood poles

Composite crossarms

Transformer Losses

Submit certification from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Losses."

SD-09 Manufacturer's Field Reports

Overhead-type distribution transformer routine and other tests

SD-11 Closeout Submittals

Transformer test schedule

1.5 QUALITY ASSURANCE

1.5.1 Ground Resistance Test Reports

Submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

1.5.2 Field Test Plan

Provide a proposed field test plan 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

1.6 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's

published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS O5.1. Handling of wood poles shall be in accordance with ATIS O5.1, except that pointed tools capable of producing indentations more than inch in depth shall not be used. Nails and holes are not permitted in top of poles. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Consider materials specified herein or shown on contract drawings which are identical to materials listed in RUS 202-1 as conforming to requirements.

2.2 POLES

Poles shall be of lengths and classes indicated.

2.2.1 Wood Poles

Wood poles machine trimmed by turning, Southern Yellow Pine conforming to ATIS O5.1 and RUS 1728F-700. Gain, bore and roof poles before treatment. Should additional gains be required subsequent to treatment, metal gain plates shall be provided. Pressure treat poles with pentachlorophenol, ammoniacal copper arsenate (ACA), chromated copper arsenate (CCA), except that Douglas Fir and Western Larch poles shall not be treated with CCA in accordance with AWPA C1 and AWPA C4 as referenced in RUS 1728F-700. The quality of each pole shall be ensured with "WQC" (wood quality control) brand on each piece, or by an approved inspection agency report.

2.3 CROSSARMS

2.3.1 Composite Crossarms

2.3.2 Crossarm Braces

Provide flat steel or steel angle as indicated. Provide braces with 38 inch span for 8 foot crossarms and 60 inch span for 10 foot crossarms.

2.3.3 Armless Construction

Pole mounting brackets for line-post or pin insulators and eye bolts for suspension insulators shall be as shown. Brackets shall be attached to poles with a minimum of two bolts. Brackets may be either provided integrally as part of an insulator or attached to an insulator with a suitable stud. Bracket mounting surface shall be suitable for the shape of the pole. Brackets for wood poles shall have wood gripping members. Horizontal offset brackets shall have a 5-degree uplift angle. Pole top brackets shall conform to IEEE C135.22, except for modifications necessary to provide support for a line-post insulator. Brackets shall provide a strength exceeding that of the required insulator strength, but in no case less than a 2800 pound cantilever strength.

2.4 HARDWARE

Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.5 INSULATORS

Provide wet-process porcelain insulators which are radio interference free.

a. Line post type insulators: NEMA C29.7, As indicated.

b. Suspension insulators: NEMA C29.2 As indicated.

c. Spool insulators: NEMA C29.3, As indicated.

d. Guy strain insulators: NEMA C29.4, As indicated.

e. Pin insulators: NEMA C29.5, As indicated.

2.6 OVERHEAD CONDUCTORS

Conductors of bare copper, aluminum (AAC), aluminum alloy (AAAC) of sizes and types indicated.

2.6.1 Solid Copper

ASTM B 1, ASTM B 2, and ASTM B 3, hard-drawn, medium-hard-drawn, and soft-drawn, respectively. ASTM B 8, stranded.

2.6.2 Aluminum

ASTM B 231/B 231M.

2.6.2.1 Aluminum Alloy

ASTM B 397 or ASTM B 399/B 399M.

2.7 NEUTRAL-SUPPORTED SECONDARY AND SERVICE DROP CABLES

Service and Secondary cables shall be as indicated with cross-linked polyethylene insulation on the phase conductors. Neutral shall be bare as indicated and shall be the same size as the phase conductors unless otherwise indicated. Cables shall conform to NEMA WC 70 and NEMA WC 71 for cross-linked polyethylene insulation.

2.8 GUY STRAND

ASTM A 475, high-strength, Class A or B, galvanized strand steel cable. Guy strand shall be 3/8 inch in diameter with a minimum breaking strength of _____ pounds. Provide guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

2.9 ROUND GUY GUARDS

Vinyl or PVC material, white, yellow colored, 8 feet long and shatter resistant at sub-zero temperatures.

2.9.1 Guy Attachment

Thimble eye guy attachment.

2.10 ANCHORS AND ANCHOR RODS

Anchors shall be screw anchors. Anchor rods shall be twin thimble-eye, one inch diameter by 8 feet long. Anchors and anchor rods shall be hot dip galvanized.

2.10.1 Screw Anchors

As indicated.

2.11 GROUND RODS

Copper clad steel, Sectional type ground rods at least 3/4 inch in diameter and 10 feet long. Die-stamp each near top with name or trademark of manufacturer and length of rod in feet. Rods shall have a hard, clean, smooth, continuous, surface throughout length of rod.

2.11.1 Ground Wire

Provide soft drawn copper wire ground conductors a minimum No. 4 AWG. Ground wire protectors may be either PVC or half round wood molding. Wood molding shall be fir, pressure treated in accordance with AWPA C25, or shall be cypress or cedar.

2.12 SURGE ARRESTERS

IEEE C62.11, metal oxide, polymer, surge arresters arranged for crossarm and equipment mounting. RMS voltage rating shall be 10 kV. Arresters shall be Distribution class.

2.13 FUSED CUTOUTS

Open, Enclosed type fused cutouts rated 100 amperes and _____ amperes symmetrical interrupting current at 15 kV ungrounded, 8.3/15 kV gnd Y, 15/26 kV gnd Y, 27/34.5 kV gnd Y, conforming to NEMA C37.42. Type K fuses conforming to NEMA C37.42 with ampere ratings as indicated. Open link type fuse cutouts are not acceptable. Provide heavy duty open drop-out type, rated 15 kV, 200 Amp, 7,100 Amp I.C. (Sym.).

2.14 CONDUIT RISERS AND CONDUCTORS

The riser shield shall be rigid galvanized steel conduit, as indicated, and conforming to UL 6. Provide conductors and terminations as specified in Section 33 71 02 "Underground Transmission and Distribution.", Section 33 70 02.00 10 "Electrical Distribution System, Underground."

2.15 TRANSFORMER (OVERHEAD-TYPE DISTRIBUTION)

a. NEMA C57.12.20.

b. Single phase, self-cooled, 65 degrees C. continuous temperature rise, two winding, 60 Hertz.

c. Insulating liquid:

(1) Mineral oil per ASTM D 3487, Type II, tested in accordance with ASTM D 117.

(2) Provide identification of transformer as "non-PCB" on the nameplate.

(3) Do not provide insulating liquids containing polychlorinated biphenyls (PCB) or tetrachloroethylene (TCE) or perchloroethylene.

d. Ratings:

(1) kVA: As indicated.

(2) BIL: As indicated.

(3) Primary voltage: As indicated.

(4) Secondary voltage: As indicated.

(5) Minimum Tested Impedance at 85 degrees C: As indicated.

e. Single-phase connections:

(1) Connect primary: As indicated.

(2) Provide transformer with _____ high voltage bushing(s).

f. Three-phase connections:

(1) Connect primary: As indicated.

(2) Connect secondary: As indicated.

(3) Provide transformer with _____ high voltage bushings.

g. Taps:

(1) Provide four 2 1/2 percent full capacity taps, 2 above and 2 below rated primary voltage. Tap changer shall have external handle.

h. Corrosion Protection:

Paint coating system shall comply with NEMA C57.12.28 regardless of tank and cover material. Finish coat shall be light gray, ANSI color No. 70.

j. Show transformer kVA capacity using 2 1/2 inch Arabic numerals placed near the low-voltage bushings.

2.16 POLE TOP SWITCH

Pole top switch shall comply with IEEE C37.30, shall be horizontal type switches, three-pole gang operated, with a padlock arrangement for locking in both open and closed positions. Steel parts shall be hot-dip galvanized. Operating rods shall be isolated from the switch by an insulating link or section located as close to the switch as possible. Switch shall be designed as indicated.

2.17 RECLOSER

IEEE C37.60. Recloser controller shall be electronically operated and utilize oil or vacuum operating medium.

2.18 SECTIONALIZER

IEEE C37.63.

2.19 GROUP-OPERATED LOAD INTERRUPTER SWITCHES

2.19.1 Manually Operated Type (Switch Handle Operated)

Manually operated (switch handle operated) load interrupter switches shall comply with NEMA C37.32 and shall be of the outdoor, manually-operated, three-pole, single-throw type with either tilting or rotating insulators. Switches shall be equipped with interrupters capable of interrupting currents equal to the switch's continuous current rating. Each switch shall be preassembled for the indicated configuration and mounting. Moving contacts shall be of the high-pressure, limited-area type, designed to ensure continuous surface contact. Switches shall be fused or non-fused as indicated. Switches shall be complete with necessary operating mechanisms, handles, and other items required for manual operation from the ground. Switch operating handles shall be located approximately 3 feet 6 inches above final grade. Insulation of switch operating mechanisms shall include both insulated interphase rod sections and insulated vertical shafts. Each handle shall be provided with a padlock arranged to lock the switch in both the open and the closed position.

2.20 METERING EQUIPMENT

Pole mounted metering equipment shall include current transformers, potential transformers, watthour meter, meter test switch block, metering enclosure, wire, conduit and fittings.

2.20.1 Potential Transformers

Potential transformers shall be rated for outdoor service fitted for crossarm mounting and secondary connection box for conduit connection. Voltage rating shall be as indicated. Transformers shall conform to the requirements of IEEE C57.13 and as indicated.

2.20.2 Current Transformers

Current transformers shall be rated for outdoor service with crossarm mounting and secondary connection box for conduit connection. Voltage rating shall be as indicated. Current rating shall be as indicated. Transformers shall conform to requirements of IEEE C57.13, and as indicated.

2.20.3 Watthour Meter

Provide meter with provisions for future pulse initiation.

a. Meters: NEMA C12.10 and NEMA C12.1; when providing meter with electronic time-of-use register.

   (1) Form: As indicated.

   (2) Element: As indicated.

(3) Voltage: 120 volts.

(4) Current: 2 1/2 amperes.

(5) Frequency: 60 hertz.

(6) Kilowatt hour register: 5 dial or 5 digit type.

b. Demand register:

(1) Solid state type.

(2) Meter reading multiplier:

(a) Indicate multiplier on the meter face.

(b) Provide multiplier in even hundreds.

(3) Demand interval length: As indicated.

c. Mounting:

(1) Provide meter with matching socket per IEEE C12.7 with manual, automatic current short-circulating device. "A" base type mounting.

2.20.4 Meter Test Block

Provide meter test block as indicated. Current switches shall short circuit current supply before opening meter circuit. Switch handles of potential switches shall be black. Switch handles of current switches shall be red.

2.20.5 Metering Enclosure

Metering enclosure shall be as indicated. Internal space shall be adequate to house equipment and wiring but not smaller than 20 by 30 by 11 inches deep. Paint metal manufacturer's standard finish.

2.21 ELECTRICAL TAPES

Tapes shall be UL listed for electrical insulation and other purposes in wire and cable splices. Terminations, repairs and miscellaneous purposes, electrical tapes shall comply with UL 510.

2.22 CALKING COMPOUND

Compound for sealing of conduit risers shall be of a puttylike consistency workable with hands at temperatures as low as 35 degrees F, shall not slump at a temperature of 300 degrees F, and shall not harden materially when exposed to air. Compound shall readily calk or adhere to clean surfaces of the materials with which it is designed to be used. Compound shall have no injurious effects upon the workmen or upon the materials.

2.23 SOURCE QUALITY CONTROL

2.23.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

(2) The accuracy shall be directly traceable to the National Institute of Standards and Technology.

(3) Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels shall be visible on all test equipment.

(5) Calibrating standard shall be of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.23.2 Routine and Other Tests

IEEE C57.12.00 and IEEE C57.12.90. Routine and other tests shall be performed by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests shall be as follows:

a. Polarity

b. Ratio

c. No-load losses (NLL) and excitation current

d. Load losses (LL) and impedance voltage

e. Dielectric

(1) Impulse

(2) Applied voltage

(3) Induced voltage

f. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Provide overhead pole line installation conforming to requirements of IEEE C2, CALPUC G.O. 95 for Grade C construction of overhead lines in light, medium, heavy loading districts and NFPA 70 for overhead services. Provide material required to make connections into existing system and perform excavating, backfilling, and other incidental labor. Consider street, alleys, roads and drives "public." Pole configuration shall be as indicated.

3.1.1 Wood Pole Installation

Provide pole holes at least as large at the top as at the bottom and large enough to provide 4 inch clearance between the pole and side of the hole.

3.1.1.1 Setting Depth of Pole

Pole setting depths shall be as follows:

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)
20	5.0	3.0
25	5.5	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0
60	8.0	5.0

3.1.1.2 Setting in Soil, Sand, and Gravel

"Setting in Soil" depths, as specified in paragraph entitled "Setting Depth of Pole," apply where the following occurs:

a. Where pole holes are in soil, sand, or gravel or any combination of these;

b. Where soil layer over solid rock is more than 2 feet deep;

c. Where hole in solid rock is not substantially vertical; or

d. Where diameter of hole at surface of rock exceeds twice the diameter of pole at same level.

3.1.1.3 Setting in Solid Rock

"Setting in Solid Rock," as specified in paragraph entitled "Setting Depth of Pole," applies where poles are to be set in solid rock and where hole is substantially vertical, approximately uniform in diameter and large enough to permit use of tamping bars the full depth of hole.

3.1.1.4 Setting With Soil Over Solid Rock

Where a layer of soil 2 feet or less in depth over solid rock exists, depth of hole shall be depth of soil in addition to depth specified under "Setting in Solid Rock" in paragraph entitled "Setting Depth of Pole," provided, however, that such depth shall not exceed depth specified under "Setting in Soil."

3.1.1.5 Setting on Sloping Ground

On sloping ground, always measure hole depth from low side of hole.

3.1.1.6 Backfill

Thoroughly tamp pole backfill for full depth of the hole and mound excess fill around the pole.

3.1.1.7 Setting Poles

Set poles so that alternate crossarm gains face in opposite directions, except at terminals and dead ends where gains of last two poles shall be on side facing terminal or dead end. On unusually long spans, set poles so that crossarm comes on side of pole away from long span. Where pole top pins are used, they shall be on opposite side of pole from gain, with flat side against pole.

3.1.1.8 Alignment of Poles

Set poles in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked against the strain. Set not less than 2 inches for each 10 feet of pole length above grade, nor more than 4 inches for each 10 feet of pole length after conductors are installed at required tension. When average ground run is level, consecutive poles shall not vary more than 5 feet in height. When ground is uneven, poles differing in length shall be kept to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, a piece shall be sawed off the top. Holes shall be dug large enough to permit the proper use of tampers to full depth of hole.

3.1.1.9 Pole Caps

Provide plastic pole caps with 1/4 inch sealing rings and four nailing tabs. Fill sealing area with either a bituminous, elastigum roof cement or an acceptable preservative paste to level of sealing ring to eliminate possibility of condensation. Place on pole top and nail each tab down with a 1 1/4 inch nail.

3.1.2 Anchors and Guys

Place anchors in line with strain. The length of the guy lead (distance from base of pole to the top of the anchor rod) shall be as indicated.

3.1.2.1 Setting Anchors

Set anchors in place with anchor rod aligned with, and pointing directly at, guy attachment on the pole with the anchor rod projecting 6 to 9 inches out of ground to prevent burial of rod eye.

3.1.2.2 Screw Anchors

Install screw anchors by torquing with boring machine.

3.1.2.3 Swamp Anchors

Install swamp anchors by torquing with boring machine or wrenches, adding sections of pipe as required until anchor helix is fully engaged in firm soil.

3.1.2.4 Setting Guy Strands

Complete anchor and guy installation, dead end to dead end, and tighten guy before wire stringing and sagging is begun on that line section. Provide strain insulators at a point on guy strand 8 feet minimum from the ground and 6 feet minimum from the surface of pole. Effectively ground and bond guys to the system neutral.

3.1.3 Hardware

Provide hardware with washer against wood and with nuts and lock nuts applied wrench tight. Provide locknuts on threaded hardware connections. Locknuts shall be M-F style and not palnut style.

3.1.4 Grounding

Unless otherwise indicated, grounding shall conform to IEEE C2. Pole grounding electrodes shall have a resistance to ground not exceeding 25 ohms. When work in addition to that indicated or specified is directed in order to obtain specified ground resistance, provisions of the contract covering changes shall apply.

3.1.4.1 Ground Rod Connections

Make ground rod connections on pole lines by exothermic weld or by using a compression connector for ground wire or wire to rod connections. Make exothermic welds strictly in accordance with manufacturer's written recommendations. Welds which have puffed up or which show convex surfaces indicating improper cleaning, are not acceptable. No mechanical connectors are required at exothermic weldments. Compression connectors shall be type that uses a hydraulic compression tool to provide correct pressure. Provide tools and dies recommended by compression connector manufacturer. An embossing die code or similar method shall provide visible indication that a connector has been fully compressed on ground wire.

3.1.4.2 Grounding and Grounded Connections

a. Where no primary or common neutral exists, surge arresters and frames of equipment operating at over 750 volts shall be bonded together and connected to a dedicated primary grounding electrode.

b. Where no primary or common neutral exists, transformer secondary

neutral bushing, secondary neutral conductor, and frames of equipment operating at under 750 volts shall be bonded together and connected to a dedicated secondary grounding electrode.

c. When a primary or common neutral exists, connect all grounding and grounded conductors to a common grounding electrode.

3.1.4.3 Protective Molding

Protect grounding conductors which are run on surface of wood poles by wood molding or plastic molding of equal mechanical strength extending from ground line throughout communication and transformer spaces.

3.1.5 CONDUCTOR INSTALLATION

3.1.5.1 Line Conductors

Unless otherwise indicated, conductors shall be installed in accordance with manufacturer's approved tables of sags and tensions. Conductors shall be handled with care necessary to prevent nicking, kinking, gouging, abrasions, sharp bends, cuts, flattening, or otherwise deforming or weakening conductor or any damage to insulation or impairing its conductivity. Remove damaged sections of conductor and splice conductor. Conductors shall be paid out with the free end of conductors fixed and cable reels portable, except where terrain or obstructions make this method unfeasible. Bend radius for any insulated conductor shall not be less than the applicable NEMA specification recommendation. Conductors shall not be drawn over rough or rocky ground, nor around sharp bends. When installed by machine power, conductors shall be drawn from a mounted reel through stringing sheaves in straight lines clear of obstructions. Initial sag and tension shall be checked by the Contractor, in accordance with the manufacturer's approved sag and tension charts, within an elapsed time after installation as recommended by the manufacturer.

3.1.5.2 Connectors and Splices

Conductor splices, as installed, shall exceed ultimate rated strength of conductor and shall be of type recommended by conductor manufacturer. No splice shall be permitted within 10 feet of a support. Connectors and splices shall be mechanically and electrically secure under tension and shall be of the nonbolted compression type. The tensile strength of any splice shall be not less than the rated breaking strength of the conductor. Splice materials, sleeves, fittings, and connectors shall be noncorrosive and shall not adversely affect conductors. Aluminum-composition conductors shall be wire brushed and an oxide inhibitor applied before making a compression connection. Connectors which are factory-filled with an inhibitor are acceptable. Inhibitors and compression tools shall be of types recommended by the connector manufacturer. Primary line apparatus taps shall be by means of hot line clamps attached to compression type bail clamps (stirrups). Low-voltage connectors for copper conductors shall be of the solderless pressure type. Noninsulated connectors shall be smoothly taped to provide a waterproof insulation equivalent to the original insulation, when installed on insulated conductors. On overhead connections of aluminum and copper, the aluminum shall be installed above the copper.

3.1.5.3 Conductor-To-Insulator Attachments

Conductors shall be attached to insulators by means of clamps, shoes or tie

wires, in accordance with the type of insulator. For insulators requiring conductor tie-wire attachments, tie-wire sizes shall be as indicated in TABLE II.

TABLE II

TIE-WIRE REQUIREMENTS

CONDUCTOR Copper (AWG)	TIE WIRE Soft-Drawn Copper (AWG)
6	8
4 and 2	6
1 through 3/0	4
4/0 and larger	2
AAC, AAAC, or ACSR (AWG)	AAAC OR AAC (AWG)
Any size	6 or 4

3.1.5.4 Armor Rods

Armor rods shall be provided for AAC and AAAC. Armor rods shall be installed at supports, except armor rods will not be required at primary dead-end assemblies if aluminum or aluminum-lined zinc-coated steel clamps are used. Lengths and methods of fastening armor rods shall be in accordance with the manufacturer's recommendations. For span lengths of less than 200 feet, flat aluminum armor rods may be used. Flat armor rods, not less than 0.03 by 0.25 inch shall be used on No. 1 AWG AAC and AAAC and smaller conductors and on No. 5 AWG ACSR and smaller conductors. On larger sizes, flat armor rods shall be not less than 0.05 by 0.30 inches. For span lengths of 200 feet or more, preformed round armor rods shall be used.

3.1.5.5 Ties

Provide ties on pin insulators tight against conductor and insulator and ends turned down flat against conductor so that no wire ends project.

3.1.5.6 Reinstalling Conductors

Existing conductors to be reinstalled or resagged shall be strung to "final" sag table values indicated for the particular conductor type and size involved.

3.1.5.7 New Conductor Installation

String new conductors to "initial" sag table values indicated, recommended by the manufacturer for conductor type and size of conductor and ruling span indicated.

3.1.5.8 Fittings

Dead end fittings, clamp or compression type, shall conform to written recommendations of conductor manufacturer and shall develop full ultimate strength of conductor.

3.1.5.9 Aluminum Connections

Make aluminum connections to copper or other material using only splices, connectors, lugs, or fittings designed for that specific purpose. Keep a copy of manufacturer's instructions for applying these fittings at job site for use of the inspector.

3.1.6 Pole Mounted Metering Equipment

3.1.6.1 Primary Meters

Install primary metering transformers as indicated. Make connections to metering circuits within each transformer conduit connection box.

3.1.6.2 Installing Meter System

Metering enclosure shall house kWh meter and meter test block. Secure the enclosure to pole at a height of 6 feet above grade to center of the enclosure. Ground enclosure.

a. Connect meter as indicated.

b. Connect meter test block between meter and metering transformers to isolate meter for removal, test or adjustment.

c. Phase sequence and color code of potential and current leads shall be identical. Mark wires which are connected to transformer terminals identified with polarity marks (dots) by a colored plastic tape around the wire at each end.

d. No splices are permissible in metering circuits. Wire shall be trained at sides and bottom of enclosure back board and secured by plastic wraps.

3.1.7 Pole Top Switch Installation

Install pole top switch strictly according to manufacturer's installation drawings and information.

3.1.7.1 Operating Handle

Locate approximately 5 feet above ground on field side of pole.

3.1.8 Recloser

Install recloser(s) strictly in accordance with manufacturer's instructions.

3.1.9 Sectionalizer

Install sectionalizer(s) strictly in accordance with manufacturer's instructions.

3.1.10 Risers

Secure galvanized steel conduits on poles by two hole galvanized steel pipe straps spaced as indicated and within 3 feet of any outlet or termination. Ground metallic conduits.

3.2 TRANSFORMER INSTALLATION

Transformers shall be carefully installed so as not to scratch finishes or damage bushings. Transformers shall be installed in accordance with the manufacturer's instructions. After installation, surfaces shall be inspected and scratches shall be touched up with a finish provided by the transformer manufacturer for this purpose.

3.3 FIELD QUALITY CONTROL

3.3.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer _____ days prior to conducting tests. The Contractor shall furnish materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field reports will be signed and dated by the Contractor.

3.3.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.3.3 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.3.3.1 Overhead-Type Distribution Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

(4) Perform specific inspections and mechanical tests as recommended by manufacturer.

(5) Verify correct equipment grounding.

b. Electrical tests

(1) Insure that the series-multiple voltage-changing switch is in the correct position. Transformers are normally shipped in the series position.

(2) Perform insulation-resistance tests.

(3) Perform continuity test.

(4) Set tap changer to provide a secondary voltage as indicated.

3.3.3.2 Pole Top Interrupter Switch

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify appropriate equipment grounding.

(4) Perform mechanical operator tests in accordance with manufacturer's instructions.

(5) Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation, and mechanical operation.

b. Electrical Tests

(1) Perform insulation-resistance tests.

(2) Perform dc over-potential tests.

(3) Perform contact-resistance tests across each switch blade.

3.3.3.3 Reclosers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect alignment and grounding.

(4) Perform mechanical operation and contact alignment tests on both the recloser and its operating mechanism in accordance with manufacturer's instructions.

(5) Verify tightness of accessible bolted electrical connections.

(6) Inspect for correct insulating liquid level.

b. Electrical Tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

(2) Perform a contact resistance test

(3) Sample insulating liquid. Sample shall be tested for:

(a) Dielectric breakdown voltage

(b) Color

(c) Visual condition

(4) Test protective functions.

(5) Perform vacuum bottle integrity test (overpotential) across each vacuum bottle with the recloser in the open position in strict accordance with manufacturer's instructions.

(6) Perform overpotential tests.

(7) Determine time delay for each programmed reclosing interval.

(8) Verify lockout for unsuccessful reclosing.

(9) Determine reset time.

(10) Verify instantaneous overcurrent lockout.

3.3.3.4 Sectionalizers

a. Visual and Mechanical inspection

(1) Compare equipment nameplate data with approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect alignment and grounding.

(4) Perform mechanical operation and contact alignment tests on both the sectionalizer and its operating mechanism in accordance with manufacturer's instructions.

(5) Verify tightness of accessible bolted electrical connections.

(6) Inspect for correct insulating liquid level.

b. Electrical Tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

(2) Perform a contact resistance test.

(3) Sample insulating liquid. Sample shall be tested for:

(a) Dielectric breakdown voltage

(b) Color

(c) Visual condition

(4) Perform overpotential tests.

(5) Test sectionalizer counting function.

(6) Test sectionalizer lockout function.

(7) Test for reset timing on trip actuator.

3.3.3.5 Potential Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Verify correct connection.

(3) Verify that adequate clearances exist between primary and secondary circuit wiring.

(4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(5) Verify that all required grounding and shorting connections provide good contact.

(6) Verify correct fuse sizes.

b. Electrical Tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter

(2) Perform insulation-resistance tests.

(3) Perform polarity tests.

(4) Perform turns-ratio tests.

3.3.3.6 Current Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(5) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter

(2) Perform insulation-resistance tests.

(3) Perform polarity tests.

(4) Perform ratio-verification tests.

3.3.3.7 Metering

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Verify accuracy of meters at 25 percent, 50 percent, 75 percent, and 100 percent of full scale.

(2) Calibrate watthour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

3.3.3.8 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.3.4 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least three times, demonstrating satisfactory operation each time.

3.3.5 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of

checking and testing.

-- End of Section --

SECTION 33 71 02

UNDERGROUND TRANSMISSION AND DISTRIBUTION

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS1	(1990) Impregnated Paper Insulated, Lead Covered Cable, Solid Type
AEIC CS6	(1987; R 1989) Ethylene Propylene Rubber Insulated Shielded Power Cable Rated 5 Through 69 kV

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C119.1	(1986; R 1997) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM F 512	(1995) Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 48	(1996) High-Voltage Alternating-Current Cable Terminations
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000-138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500-500,000 V

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	(1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 8	(1990) Extra-Strength PVC Plastic Utilities Duct for Underground Installation
NEMA TC 9	(1990) Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
NEMA WC 7	(1993) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1993) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1991) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 70B	(1998) Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 83	(1998) Thermoplastic-Insulated Wires and Cables
UL 467	(1993; Bul. 1994, R 1996) Grounding and Bonding Equipment
UL 486A	(1997; R 1998) Wire Connectors and Soldering Lugs for Use With Copper Conductors
UL 510	(1994; R 1998) Chloride, Polyethylene, and Rubber Insulating Tape

UL 514A	(1996; R 1998) Metallic Outlet Boxes
UL 514B	(1997; R 1998) Fittings for Cable and Conduit
UL 651	(1995; R 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 854	(1996; Bul. 1997 R 1998) Service-Entrance Cables
UL 1242	(1996; R 1998) Intermediate Metal Conduit

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods" and Section 33 05 13, "Electrical Manhole and Handhole," applies to this section with additions and modifications specified herein.

1.2.1 Underground Service

Terminate underground service into building at a point 5 feet outside the building and projections thereof, except that service conductors shall be continuous to the interior terminating point indicated. Connections of the service to the service switch, panelboard, or load center is included in Section 26 20 00, "Interior Distribution System." Protect ends of underground conduit with threaded metal caps or plastic plugs as applicable until connections are made.

1.3 DEFINITIONS

a. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

b. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Proposed precast sectional underground duct bank

SD-03 Product Data

Medium voltage cable

Medium voltage cable joints

Medium voltage cable terminations

Live end caps

600 volt wires and cables

Paper insulated lead covered (PILC) cables

SD-06 Test Reports

Acceptance checks and tests

Identify each cable for 600-volt, and medium voltage cable tests. When testing grounding electrodes and systems, identify each electrode and system for each test, as well as the resistance and soil conditions at the time the measurement were made.

SD-07 Certificates

Cable splicer/terminator

Cable splicer qualifications

Thirty calendar days before making splices or terminations, submit names of the cable splicers to be employed, together with proof that splicer has at least 3 years experience in splicing the type and rating of cables specified. Submit certification for each splicer by the cable joint kit manufacturer in the use of manufacturer's kits.

SD-08 Manufacturer's Instructions

Ground megger

"UL listed" kit

Termination kit

Medium-voltage joints

SD-09 Manufacturer's Field Reports

Arc-proofing test for cable fireproofing tape

Medium voltage cable tests

Factory engineered heat shrinkable joint kit

1.5 QUALITY ASSURANCE

Each cable splicer may be required to make an approved dummy splice in the presence of the Contracting Officer in accordance with cable manufacturer's instructions. The Contractor shall furnish the material for dummy splices.

1.5.1 Cable Splicer Qualifications

a. In order to establish the cable workman's competency, the Contractor shall be required to submit the following within 30 calendar days prior to commencement of the splice/termination:

(1) Documentation to verify that the individual has completed a splice/termination of the type to be installed under this contract. The test splice-termination shall be performed at the job site for this contract under the supervision of the cable accessory manufacturer or his representative and witnessed by the

Government.

(2) Documentation that said splice/termination has undergone and passed the following tests by the splice-termination manufacturer or an independent testing laboratory.

TEST	Minimum Value 5 kV	15 kV	35 kV
Discharge Ext. Value with 3 pC or less	13 kV	20 kV	35 kV
AC withstand, 1 minute	35 kV	50 kV	75 kV
DC withstand, 15 minutes	65 kV	70 kV	100 kV

These results shall be attached for review

(3) A statement of the number of years in which the individual has been splicing/terminating medium voltage cable.

b. Criteria for waiver: Items a.1 and a.2 above may be waived on subsequent jobs provided the following criteria is satisfied:

(1) Documentation of prior completion of items a.1 and a.2 be submitted.

(2) A list of the last three jobs where the specific splices/terminations were installed within the past 12 consecutive months. The tabulation shall include splice/termination manufacturer, catalog number, and the number of splice/terminations installed.

c. Requalifications: Requalification to items a.1 and a.2 in above paragraph may be required if the splice installer can not demonstrate a prior history of splice/termination installation during the previous 12 consecutive months. The contractor shall furnish the material for splices and terminations.

1.5.2 Test Instrument and Procedure

Submit for use of ground megger with proposed method indicated.

1.5.3 Manufacturer's Test

Submit the manufacturer's test report indicating that performance of the heat shrinkable joint kit is equivalent to the cable rating, in accordance with the applicable sections of IEEE Std 48, IEEE Std 404, and AEIC CS1.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Conduit

2.1.1.1 Rigid Metal Conduit

UL 6, galvanized steel, threaded type.

2.1.1.2 Rigid Metal Conduit, PVC Coated

UL 6, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.1.3 Intermediate Metal Conduit

UL 1242, galvanized steel, threaded type.

2.1.1.4 Intermediate Metal conduit, PVC Coated

UL 1242, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.1.5 Plastic Conduit for Direct Burial

NEMA TC 2, as indicated.

2.1.1.6 Plastic Utilities Duct for Concrete Encasement

NEMA TC 8, ASTM F 512, as indicated.

NEMA TC 6, Type as indicated.

2.1.2 Fittings

2.1.2.1 Metal Fittings

UL 514B, threaded type.

2.1.2.2 PVC Conduit Fittings

NEMA TC 3 UL 514B, UL 651.

2.1.2.3 PVC Duct Fittings

NEMA TC 9.

2.1.2.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

2.1.3 Conductors Rated 600 Volts and Less

Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site

shall not be used.

2.1.3.1 600 Volt Wires and Cables

Service entrance and direct buried conductors shall conform to UL 854, Type USE. Conductors in conduit other than service entrance shall conform to UL 83, Type THWN or THW. Conductor size and number of conductors in each cable shall be as indicated. Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, or heat shrink type sleeves. Control circuit terminations shall be properly identified. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper.

a. Colors for coding conductors shall be:

208-VOLT SYSTEM	480-VOLT SYSTEM
Neutral - White	Neutral - White
Phase A - Black	Phase A - Brown
Phase B - Red	Phase B - Orange
Phase C - Blue	Phase C - Yellow
Grounding conductor - Green	Grounding conductor - Green

2.1.4 600 Volt Wire Connector and Terminals

Shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors.

a. For use with copper conductors: UL 486A.

2.1.5 600 Volt Splices

Provide splices with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply ANSI C119.1.

a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package.

b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold.

c. Provide heavy wall heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied by a clean burning propane gas torch.

d. Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not

require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.1.6 Medium Voltage Cable

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted.

Cable as indicated for kV underground distribution system shall be ozone resistant ethylene-propylene-rubber-insulated (EPR) cable conforming to NEMA WC 8, as applicable, and AEIC CS6. Cable shall be single, three conductor, employing concentric, Class B, compact round stranded copper conductors. Cable shall have conductor and insulation shielding. Insulation shielding shall be metal tape type consisting of a concentric serving of tape according to NEMA WC 8 or NEMA WC 7. Cable shall be rated 15 kV with insulation and jacket thickness of 133%, respectively. Cable shall have a polyvinyl chloride jacket.

2.1.7 Medium Voltage Cable Terminations

IEEE Std 48 Class 1. Provide terminations including stress control terminator, ground clamp, connectors, and lugs. Terminator shall be the product of one manufacturer, suitable for the type and materials of the cable terminated. Furnish components in the form of a "UL listed" kit, including complete instructions which shall be followed for assembly and installation. Provide terminator as specified herein for terminating single conductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 KV indoor and outdoor. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.1.7.1 Indoor Terminations/Terminations Within Equipment Enclosures

Indoor terminator shall be cold-shrink type or heat shrinkable type.

a. Cold-Shrink Type:

Terminator shall be a one-piece design, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber, munsel gray in color. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall be rated for continuous operation at 90 degree C, with an emergency overload temperature rating of 130 degree C.

b. Heat Shrinkable Type

Terminator shall consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable

sheds or skirts of the same material.

2.1.7.2 Outdoor Terminations

Outdoor terminator shall be cold shrink type or porcelain insulator.

a. Cold-Shrink Type:

Terminator shall be a one-piece design, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber, munsel gray in color. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials (except for the lugs). Termination shall be designed for installation in low or highly contaminated indoor and outdoor locations and shall be rated for continuous operation at 90 degree C, with an emergency overload temperature rating of 130 degree C.

2.1.7.3 Terminator, Cold-Shrink Rubber Type, Single Conductor PILC Cable

IEEE Std 48, Class 1. Provide terminations as specified herein for terminating single conductor PILC cable. Cable termination must be a one-piece cold shrink 15 kV or 25/28 kV Class device and meet all 15 kV, 25 kV (+ prorated 28 kV) requirements for Class 1 terminations as recorded in IEEE Std 48. Termination must be a molded rubber unit where the built-in stress relief mechanism uses the concept of high dielectric constant capacitive stress grading. Molded rubber insulator must be made from silicone rubber.

2.1.8 Medium Voltage Cable Joints

Provide joints (splices) in accordance with IEEE Std 404 suitable for the rated voltage, insulation level, and insulation type of the cable. Upon request, supply manufacturer's design qualification test report in accordance with IEEE Std 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion. Connectors shall be rated for voltage of 35 kV minimum.

a. Heat-shrinkable joint: Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating, waterproof mastic seal on both ends.

b. Watertight taped-type joint: Consists of an approved connector, self-fusing or self-bonding insulating tape, self-fusing semiconducting tape, tinned copper shielding tape or braid, and plastic tape.

c. Vulcanized-type joint: Heat-pressure process of an approved type and employing materials and equipment suitable for the type and voltage of cables for which it is used. Materials used in the jointing process shall be fully and permanently compatible with materials in the cables. Vulcanized-type joints are limited to 5 kV systems.

d. Cold-shrink rubber-type joint: Joint shall be of a cold shrink

design that does not require any heat source for its installation. Splice insulation and jacket shall be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice shall be packaged three splices per kit, including complete installation instructions. Cold-shrink rubber-type joints are limited to 8.7 kV systems.

2.1.9 Live End Caps

Provide live end caps using a "kit" including a heat-shrinkable tube and a high dielectric strength, polymeric plug overlapping the conductor. End cap shall conform to applicable portions of IEEE Std 48.

2.1.10 Tape

2.1.10.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.1.10.2 Buried Warning and Identification Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried cable and conduit. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2 inchesminimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED ELECTRIC, TELEPHONE CABLE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.1.10.3 Fireproofing Tape

Fireproofing tape shall be approximately 30 mils thick by 3 inches wide and shall consist of a flexible, unsupported elastomer that expands in fire to provide a thick char buildup between the flame and the cable. Tape shall be noncorrosive to cable sheath. Tape shall not give off a smoke when subjected to flame or support combustion. Tape shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

Furnish tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.1.11 Pull Rope

Shall be plastic having a minimum tensile strength of 200 pounds. Leave a minimum of 24 inches of slack at each end of the pull wires.

2.1.12 Grounding and Bonding Equipment

UL 467. Ground rods shall be copper clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and 10 feet long unless otherwise indicated.

2.1.13 Cable Tags

Provide as specified in Section 26 00 00, "Basic Electrical Materials and Methods".

2.2 SOURCE QUALITY CONTROL

2.2.1 Medium Voltage Cable Tests

Results of AEIC C5 and AEIC CS6 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

NFPA 70 and ANSI C2 and CALPUC G.O.128.

3.1.1 Contractor Damage

The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the Contracting Officer of any such damage.

3.1.2 Concrete

Concrete work for electrical requirements shall be 3000 psiminimum ultimate 28-day compressive strength with one inchminimum aggregate conforming to the requirements of Section 03 30 00, "Cast-In-Place Concrete".

Shall be composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 3/16 to one inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete shall have a compressive strength of 3000 psi at the age of 28 days. Slump shall not exceed 3 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer. Air entrain concrete exposed to weather using and air-entraining admixture conforming to ASTM C 260. Air content shall be between 4 and 6 percent.

3.1.3 Direct Burial System

Bury cables directly in earth, except under railroad tracks, paved areas, and roadways, and install cables in conduit encased in concrete. Install cables buried directly in earth in the following manner:

a. Slope ducts to drain.

b. Excavate trenches in which the cables are placed by hand or with mechanical trenching equipment, and provide a minimum cable cover of 24 inches below finished grade for power conductors operated at 600 volts and less, and 30 inches to the top of the cables for over 600 volts. Trenches shall be not less than 6 inches wide, and shall be in straight lines between cable markers. Cable plows shall not be used. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench, space cables laterally at not less than 3 inches apart, except that communication cable shall be separated from power cable by a minimum distance of 12 inches.

c. When rock is encountered, remove to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch.

d. Do not unreel and pull cables into the trench from one end. However, the cable may be unreeled on grade and lifted into position on a 3 inch sand bedding with 3 inches more sand placed on top of cable and a redwood plank placed on top of the sand the entire length of the cable run. Plank shall be 2 by 8 inch redwood, brush treated three coats with a pentachlorophenol light oil solution. Cable bedding and cover shall consist of material which would pass a 1/4 inch screen with no sharp material.

e. Provide color, type and depth of warning tape as specified in paragraphs "BURIED WARNING AND IDENTIFICATION TAPE" in Section 31 23 00.00 20, "Excavation and Fill".

3.1.3.1 Cutting Cable

Use heat shrink adhesive coated caps on cable ends or tape cable ends immediately after cutting to prevent moisture from entering the cable. Varnish the tape when cable is not expected to be connected for at least 72 hours.

3.1.3.2 Restoration

Replace sod which has been removed, as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, pad construction, and other work to original condition and maintain until final acceptance. Provide necessary topsoiling, fertilizing, liming, or sodding. Perform work in accordance with Section, 32 92 23, "Sodding," and Section 32 93 00, "Exterior Plants."

3.1.3.3 Crossing Cables

Separate cables crossing other cables or metal piping from each other by not less than 3, 12 inches of well tamped earth.

3.1.3.4 Splicing

Provide cables in one piece without splices between connections except where the distance exceeds the lengths in which cables are manufactured.

3.1.3.5 Bends

Bends in cables shall have an inner radius not less than those specified in NFPA 70 for the type of cable specified. 12 times the cable diameter.

3.1.3.6 Horizontal Slack

Leave approximately 3 feet of horizontal slack in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections.

3.1.3.7 Cable End Seal

Ends of cable shall be taped immediately after cutting to prevent moisture from entering the cable. Where the cable is not expected to be connected for at least 72 hours, the tape shall also be varnished.

3.1.4 Underground Conduit/Duct Without Concrete Encasement

Type of conduit shall be EPC-40-PVC, EPC-80-PVC, PVC-coated rigid galvanized steel, PVC-coated intermediate galvanized steel, rigid galvanized steel, intermediate galvanized, or rigid galvanized steel field wrapped with 0.010 inch thick pressure-sensitive plastic tape applied with a 50 percent overlap.

3.1.4.1 Conduit Installation

Top of the conduit shall be not less than 24 inches below grade, and shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points. Run conduit in straight lines except where a change of direction is necessary. As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. Provide not less than 3 inches clearance from the conduit to each side of the trench. A minimum clearance of 2 1/2 inches shall be provided between adjacent conduits. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. Provide color, type and depth of warning tape as specified in paragraphs "BURIED WARNING AND IDENTIFICATION TAPE" in Section 31 23 00.00 20, "Excavation and Fill".

3.1.4.2 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks. Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, shall be zinc-coated, rigid steel, jacked into place. Hydraulic jet method shall not be used.

3.1.4.3 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 1/2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.1.5 Underground Duct with Concrete Encasement

Construct underground duct lines of individual conduits encased in concrete. Except where rigid galvanized steel conduit is indicated or specified, the conduit shall be PVC Type EB-35. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than 4 inches in diameter unless otherwise indicated. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches. Provide color, type and depth of warning tape as specified in paragraphs "BURIED WARNING AND IDENTIFICATION TAPE" in Section 31 23 00.00 20, "Excavation and Fill".

3.1.5.1 Depth of Encasement

Top of the concrete encasement shall not be less than 18 inches below grade except that under roads and pavement concrete be a minimum of 24 inches below grade and under railroad tracks a minimum of 50 inches below top of rails.

3.1.5.2 Slope of Encasement

Duct banks shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet; sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.

3.1.5.3 Conduits

Terminate conduits in end-bells where duct lines enter underground structures. Stagger conduit joints by rows and layers to strengthen the duct bank. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacture's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring

concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.

3.1.5.4 Test Mandrel

As each section of a duct line is completed from structure to structure, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the diameter of the conduit through each conduit. After which, draw a stiff bristle brush through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs.

3.1.5.5 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.1.5.6 Connections to Manholes

Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.1.5.7 Connections to Existing Manholes, Handholes

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.1.5.8 Connections to Existing Concrete Pads

For duct bank connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and bend out to tie into the reinforcing of the duct bank envelope. Chip out the opening in the pad to form a key for the duct bank envelope.

3.1.5.9 Connections to Existing Ducts

Where connections to existing duct banks are indicated, excavate the banks to the maximum depth necessary. Cut off the banks and remove loose concrete from the conduits before new concrete-encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks.

3.1.5.10 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately one footapart. Restrain reinforcing assembly from moving during concrete pouring.

3.1.5.11 Removal of Ducts

Where duct lines are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

3.1.5.12 Optional Precast Sectional Underground Duct Bank

The Contractor may choose to substitute concrete, precast, sectional, underground duct bank, with PVC conduits, for the cast-in-place underground conduit with concrete encasement. Key and tie together precast sections in a manner to provide the strength and integrity of a cast-in-place structure. Keep conduits in alignment from section to section to provide a smooth surface for pulling cables. Lock precast sections together so that the maximum gap after settlement does not exceed 1/4 inch. Fill gaps between concrete sections with flexible plastic grouting material to prevent entry of water and foreign material. Install rebar in precast sections in accordance with the requirements of cast-in-place duct banks. Key the precast duct bank into manholes, with a cast-in-place section, of 3 feet minimum, joining the last section to each manhole. The alignment vertically and horizontally of any two adjacent sections shall not vary more than 1/4 inch when measured from end of conduit to end of conduit. Concrete strength shall be the same as for cast-in-place units. Precast duct banks without the PVC conduits will not be permitted.

3.1.6 Underground Conduit for Service Feeders Into Buildings

Shall be PVC, Type EPC-40 galvanized rigid steel or steel IMC from the service equipment to a point 5 feet beyond the building and projections thereof. Protect the ends of the conduit by threaded metal caps or bushings; coat the threads with graphite grease or other coating. Clean and plug conduit until conductors are installed. Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.1.7 Conduit Protection at Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.1.8 Buried Warning and Identification Tape

Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.9 Cable Pulling

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.1.9.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

3.1.9.2 Cable Pulling Tensions

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer. Monitor pulling tension during cable installation to ensure maximum pulling tension is not exceeded.

3.1.9.3 Secondary Cable Runs, 600 Volts and Less

Provide insulated copper equipment grounding conductor, sized as required by the rating of the overcurrent device supplying the phase conductors.

3.1.9.4 Cables in Manholes, and Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 4 feet. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure. In existing manholes, handholes and vaults where new ducts are to be terminated or where new cables are to be installed, modify the existing installation of cables, cable supports and grounding as required for a uniform installation with cables carefully arranged and supported in the same manner as specified for new cable. Provide cable racks in each underground structure through which cable is run.

3.1.9.5 Cable Tags in Manholes and Handholes and Vaults

Provide cable markers (or tags) as specified in Section 26 00 00, "Basic Electrical Materials and Methods."

3.1.9.6 Conductors Installed in Parallel

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and

1 neutral conductor.

3.1.10 600 Volt Cable Splicing and Terminating

Protect terminations of insulated power and lighting cables from accidental contact, deterioration of coverings and moisture by providing terminating devices and materials. Install terminations of insulated power and lighting cables and cable joints in accordance with the manufacturer's requirements. Make terminations with materials and methods as indicated or specified herein or as designated by the written instructions of the cable manufacturer and termination kitmanufacturer.

Provide splices and terminations to protect 600 volts insulated power and lighting cables from accidental contact, deterioration of coverings and moisture. Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes and handholes.

3.1.10.1 Splices for 600 Volt Class Cables

Splices in underground distribution systems shall made only in accessible locations such as manholes and handholes, with a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water and comply with pass ANSI C119.1.

a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.

b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

c. Provide heavy wall heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which should be applied by a clean burning propane gas torch. Cables may be moved when joint is cool to the touch.

d. Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as coverings or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

e. Where aluminum conductors are provided, use particular care in making up joints and terminations. Remove surface oxides by

cleaning with a wire brush or emery cloth. Provide joint compound on conductors, and UL listed solid aluminum connectors for connecting aluminum to aluminum. When connecting aluminum to copper, provide connectors specifically designed for connecting aluminum to copper.

3.1.11 Medium Voltage Cable Terminations

Provide terminating devices and materials to protect medium voltage cable terminations from accidental contact, deterioration of coverings, and moisture. Make terminations by using materials and methods specified herein and as designated by the written instruction of the cable manufacturer and termination kit manufacturer. Termination for high-voltage cables shall be rated, and be capable of withstanding test voltages, in accordance with IEEE Std 48. Terminations of single- and multiconductor cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief and grounding of cable shields of shielded cable, and grounding of neutral conductors, metallic sheaths, and armor. Adequately support cables and cable terminations to avoid any excessive strain on the termination and the conductor connection.

3.1.12 Medium Voltage Cable Joints

Provide power cable joints (splices) suitable for continuous immersion in water and direct burial. Make joints only in accessible locations in manholes or handholes by using materials and methods specified herein and as designated by the written instructions of the cable manufacturer and the joint kit manufacturer. Size connectors properly for the cable being connected and crimp using a full circle compression tool.

Provide power cable joints suitable for direct burial or continuous immersion in water and made only in accessible locations in manholes or handholes.

a. Make medium-voltage joints by using a kit of one manufacturer and with written approval of the manufacturer of the cable which is to be spliced. Provide the Contracting Officer with a copy of the manufacturer's instructions before jointing is started. Upon request, supply manufacturer's design qualification test report in accordance with IEEE Std 404. Joint design shall have been proof tested in accordance with IEEE Std 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

(1) Epoxy cast-type joint methods: Provide cast-type joint insulation by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package. Do not allow cables to be moved until after the jointing material has completely set.

(2) EPR cast-type joint: Provide insulation by means of a molded casting process employing an ethylene propylene-rubber (EPR) jointing compound which results in an inseparable bond between the jointing material and cable insulation. The molding process shall include injection of molding material into the mold to ensure

void-free joints.

(3) Watertight taped-type joint: Consists of an approved connector, self-fusing tape (splicing compound), self-bonding semiconducting tape, tinned copper shielding tape or braid, and plastic tape.

(4) Tape overcast-type joint: Watertight taped-type, overcast with an epoxy resin construction for the cast-type, pressure method. Provide joint suitable for the rated voltage of the cable, to a limit of 15 KV.

(5) Vulcanized-type joint: Heat-pressure process of an approved type and employing materials and equipment suitable for the type and voltage of cables for which it is used. Materials used in the jointing process shall be fully and permanently compatible with materials in the cables. Provide joint suitable for the rated voltage of the cable, to a limit of 5 KV.

(6) Heat-shrinkable joint: A uniform cross-section heat-shrinkable polymeric construction consisting of a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating. Provide joint suitable for the rated voltage of the cable.

(7) Cold-shrink rubber-type joint: Joint shall be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket shall be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice shall be packaged three splices per kit, including complete installation instructions. Provide joint suitable for the rated voltage of the cable, to a limit of 8.7 kV.

(8) Inline molded rubber-type joint: The concentric neutral (CN) or jacketed concentric neutral (JCN) cable joint must meet the requirements of IEEE Std 404 for the voltage rating of the cable it is to be used on 15, 25 or 35 kV. It must be rated for continuous operation at 90 degrees C, with an emergency overload temperature rating of 130 degrees C. The joint shall be a slip-on design made of molded peroxide cured EPDM rubber, with a separate jacket over the splice and neutral wires consisting of an EPDM rubber tube which has been factory stretched onto a spiraled core, which is removed during installation. The splice shall be rated for indoor, outdoor or direct burial applications.

3.1.12.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to a ground rod as part of the splice installation. Ground conductors, connections, and rods shall be as specified elsewhere in this section. Wire shall be trained to the sides of the enclosure to prevent interference with the working area.

3.1.13 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.14 Live End Caps

Provide live end caps for single conductor medium voltage cables where indicated.

3.1.15 Fireproofing of Cables in Manholes, Handholes and Vaults

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in manholes, handholes, and vaults.

3.1.15.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-laped wrapping. Install tape in accordance with manufacturer's instructions.

3.1.15.2 Tape-Wrap

Tape-wrap lead-sheathed or other metallic-sheathed or metallic armored cables without a nonmetallic protective covering over the sheath or armor prior to application of fireproofing. Wrap shall be in the form of two tightly applied half-lapped layers of a pressure-sensitive 10 mil thick plastic tape, and shall extend not less than one inch into the duct. Even out irregularities of the cable, such as at splices, with insulation putty before applying tape.

3.1.16 Grounding Systems

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Generating and control equipment 1000 volts and over: 1 ohm

Main substations, distribution substations, switching stations, primary distribution stations enclosed by fences:

500 kVA or less: 5 ohms
500 kVA to 1000 kVA: 5 ohms
1000 kVA or over: 3 ohms

Pad-mounted transformers without protective fences: 5 ohms

Ground in manholes, handholes, and vaults: 5 ohms

Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment: 5 ohms

Grounded secondary distribution system neutral and noncurrent-carrying

metal parts associated with distribution systems and grounds not otherwise covered: 5 ohms

When work in addition to that indicated or specified is directed in order to obtain the specified ground resistance, the provisions of the contract covering "Changes" shall apply.

Shall be as indicated, and as required by NFPA 70 and ANSI C2.

3.1.16.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.

3.1.16.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.16.3 Grounding Conductors

Grounding conductors shall be stranded-bare copper conforming to ASTM B 8, Class B, for sizes No. 6 AWG and larger, and shall be solid-bare copper conforming to ASTM B 1 for sizes No. 8 and smaller. Cable sheaths, cable shields, conduit, and equipment shall be grounded with No. 6 AWG, except 34.5 kV cable sheaths and cable shields shall be grounded with No. 4/0 AWG.

3.1.16.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.1.16.5 Ground Rod Connections

Connect ground rods only to insulated copper ground conductor and weld the connection. Insulate entire area of the rod in the vicinity of the weld in accordance with UL 467and the connecting wire and seal against moisture penetration.

3.1.16.6 Fence Grounding

Fences shall be grounded with a ground rod at each fixed gate post and at each corner post. Drive ground rods until the top is 12 inches below

grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 12 inches of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence. Each gate section shall be bonded to its gatepost by a 1/8 by one inch flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.1.17 Special Conditions

During the construction of duct banks and underground structures located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition. At locations where duct banks cross railroad tracks and the work requires closing of the tracks, secure permission from the Contracting Officer for each track closure.

3.1.18 Earthwork for Utilities

Section 31 23 00.00 20, "Excavation and Fill."

3.1.19 Reconditioning of Surfaces

3.1.19.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct or direct burial cable. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.19.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists , restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.1.20 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an

alternate cable splicer.

3.2 FIELD QUALITY CONTROL

As an exception to requirements that may be stated elsewhere in the contract, notify the Contracting Officer 5 working days prior to each tests. Furnish labor, equipment. and incidentals required for testing, except that the Government will provide electric power required for the tests. Correct defects in the work provided by the Contractor and repeat tests until the work is in compliance with contract requirements.

3.2.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.2.1.1 600 Volt Cable Tests

Perform tests after wiring is completed, connected, and ready for operation, but prior to placing system in service and before any branch circuit breaker is closed.

a. Visual and Mechanical Inspection

(1) Inspect cables for physical damage and proper connection in accordance with contract plans and specifications.

(2) Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench. In the absence of manufacturer's data use NETA recommended values.

(3) Check cable color coding for compliance with contract specifications.

b. Electrical Tests

(1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductor; applied potential shall be 1000 volts DC for 1 minute; minimum insulation-resistance values shall not be less than 2 megohms.

(2) Perform continuity test to insure proper cable connection.

3.2.1.2 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) If cables are terminated through window-type CT's, make an inspection to verify that neutrals and grounds are properly terminated for proper operation of protective devices.

(7) Visually inspect jacket and insulation condition.

(8) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform a DC high-potential test on all cables. Adhere to precautions and limits as specified in the applicable NEMA/ICEA Standard for the specific cable. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. Field acceptance test voltage for 15 kV cable shall be 55 kV DC 53 kV DC with insulated connectors.

(a) Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.

(b) Record wet- and dry-bulb temperatures or relative humidity and temperature.

(c) Test each section of cable individually.

(d) Individually test each conductor with all other conductors grounded; Ground all shields.

(e) Terminations shall be properly corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary.

(f) Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE standard 48 or manufacturer's specifications.

(g) Apply the DC high-potential test in at least five equal increments until maximum test voltage is reached. No increment shall exceed the voltage rating of the cable. Record DC leakage current at each step after a constant stabilization time consistent with system charging current.

(h) Raise the conductor to the specified maximum test voltage and hold for fifteen (15) minutes. Record readings of leakage current at 30 seconds and one minute and at one-minute intervals thereafter. Provide a graphic plot of readings with leakage current (X axis) versus voltage (Y axis) at each increment.

(i) Reduce the conductor test potential to zero and measure residual voltage at discrete intervals.

(j) Apply grounds for a time period adequate to drain all insulation stored charge.

(k) When new cables are spliced into existing cables, the DC high-potential test shall be performed on the new cable prior to splicing. After test results are approved for new cable and the splice is completed, an insulation-resistance test and a shield-continuity test shall be performed on the length of new and existing cable including the splice. After a satisfactory insulation-resistance test, a DC high-potential test shall be performed on the completed cable system utilizing a test voltage 75 percent of new cable tested value.

3.2.1.3 Ground Rods

Perform ground resistance tests for ground rods before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured for each piece of equipment and medium voltage cable splice to the ground electrode.

Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test.

3.2.2 Approval of Test Results

Medium voltage cable test results shall be approved.

-- End of Section --

SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

09/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(2001) Hard-Drawn Copper Wire
ASTM B 8	(2004) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 1557	(2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 709	(2001) Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA TIA/EIA-455-107A	(1999) Component Reflectance or Link/System Return Loss using a Loss Test Set
EIA TIA/EIA-455-204	(2000) FOTP-204 Measurement of Bandwidth on Multimode Fiber
EIA TIA/EIA-455-46A	(1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
EIA TIA/EIA-455-59A	(2000) FOTP-59 Measurement of Fiber Point Discontinuities Using an OTDR
EIA TIA/EIA-455-61A	(2000) FOTP-61 Measurement of Fiber or Cable Attenuation Using an OTDR
EIA TIA/EIA-455-B	(1998) Test Procedures for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (ANSI)
EIA TIA/EIA-472D000-A	(1993) Fiber Optic Communications Cable for Outside Plant Use
EIA TIA/EIA-492CAAA	(1998; R 2002) Class IVA

	Dispersion-Unshifted Single-Mode Optical Fibers
EIA TIA/EIA-526-14A (	1998) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant (ANSI/TIA/EIA-526-14A)
EIA TIA/EIA-526-7	(1998) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant (ANSI/TIA/EIA-526-7)
EIA TIA/EIA-568-B.1	(2001; Addendum 2001) Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements (ANSI/TIA/EIA-568-B.1)
EIA TIA/EIA-568-B.2	(2001) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components (ANSI/TIA/EIA-568-B.2)
EIA TIA/EIA-568-B.3	(2000; Addendum 2002) Optical Fiber Cabling Components Standard (ANSI/TIA/EIA-568-B.3)
EIA TIA/EIA-569-A	(1998; Addenda 2000, 2001) Commercial Building Standards for Telecommunications Pathways and Spaces (ANSI/TIA/EIA-569-A)
EIA TIA/EIA-590-A	(1997) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
EIA TIA/EIA-598-B	(2001) Optical Fiber Cable Color Coding
EIA TIA/EIA-606-A	(2002) Administration Standard for the Telecommunications Infrastructure (ANSI/TIA/EIA-606)
EIA TIA/EIA-758	(1999; Addendum 1999) Customer-Owned Outside Plant Telecommunications Cabling Standard (ANSI/TIA/EIA-758)
TIA J-STD-607-A	(2002) Commercial Building Grounding (Earthen) and Bonding Requirements for Telecommunications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-87-640	(1999) Fiber Optic Outside Plant Communications Cable

ICEA S-98-688	(1997) Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors
ICEA S-99-689	(1997) Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C62.61	(1993) Gas Tube Surge Arresters on Wire Line Telephone Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6	(2000) Commercial Blast Cleaning

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 1755.200	Standard for Splicing Copper and Fiber Optic Cables
RUS 1755.390	Specification for Filled Telephone Cables
RUS 1755.910	Specification for Outside Plant Housing and Serving Area Interface Systems.
RUS Bul 1751F-630	(2002) Underground Plant Design
RUS Bul 1751F-640	(1995) Design of Buried Plant, Physical Considerations
RUS Bul 1751F-643	(1996) Design of Aerial Plant
RUS Bul 1751F-815	(1979) Electrical Protection of Outside Plant
RUS Bul 1753F-201	(1997) Acceptance Tests of Telecommunications Plant (PC-4)
RUS Bul 1753F-401	(1995) Splicing Copper and Fiber Optic Cables (PC-2)
RUS Bul 345-50	(1979) Trunk Carrier Systems (PE-60)
RUS Bul 345-65	(1985) Shield Bonding Connectors (PE-65)
RUS Bul 345-72	(1985) Filled Splice Closures (PE-74)
RUS Bul 345-83	(1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)

UNDERWRITERS LABORATORIES (UL)

UL 497	(2001) Protectors for Paired Conductor

Communication Circuits

UL 83 (2003; Rev thru Mar 2004)
Thermoplastic-Insulated Wires and Cables

1.2 RELATED REQUIREMENTS

Section 27 10 00, "Building Telecommunications Cabling System"; Section 33 71 01, "Overhead Transmission and Distribution"; and Section 33 71 02.00 20, "Underground Electrical Distribution" apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in EIA TIA/EIA-568-B.1, EIA TIA/EIA-568-B.2, EIA TIA/EIA-568-B.3, EIA TIA/EIA-569-A, EIA TIA/EIA-606-A, and IEEE Std 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. International expression for main cross-connect - (MC).

1.3.2 Entrance Facility (EF)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.3 Entrance Room (ER)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.4 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. International expression for intermediate cross-connect - (IC).

1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The telecommunications outside plant consists of cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use. The telecommunications contractor must coordinate with Base Telephone concerning layout and configuration of the EF telecommunications and OSP. The telecommunications

contractor may be required to coordinate work effort for access to the EF telecommunications and OSP with Base Telephone.

1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 "Submittal Procedures":

a. Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph "Regulatory Requirements" and as required for certificates in Section 01 33 00 "Submittal Procedures".

b. Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, "Operation and Maintenance Data" and as specified herein not later than 2months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs "Telecommunications Outside Plant Shop Drawings" and "Telecommunications Entrance Facility Drawings".

SD-02 Shop Drawings

Telecommunications Outside Plant

Telecommunications Entrance Facility Drawings

SD-03 Product Data

Wire and cable

Cable splices, and connectors

Closures

Building protector assemblies

Protector modules

Cross-connect terminal cabinets

Spare Parts

SD-06 Test Reports

Pre-installation tests

Acceptance tests

Outside Plant Test Plan

SD-07 Certificates

Telecommunications Contractor Qualifications

Key Personnel Qualifications

Minimum Manufacturer's Qualifications

SD-08 Manufacturer's Instructions

Building protector assembly installation

Cable tensions

Fiber Optic Splices

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5

SD-11 Closeout Submittals

Record Documentation

In addition to other requirements, provide in accordance with paragraph "Record Documentation".

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with EIA TIA/EIA-758, RUS Bul 1751F-630 for aerial system design, RUS Bul 1751F-643 for underground duct system design and for direct buried system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in accordance with EIA TIA/EIA-606-A. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials,

and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the telecommunications outside plant. Update existing telecommunication Outside Plant T0 drawings to include information modified, deleted or added as a result of this installation in accordance with EIA TIA/EIA-606-A. The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility Drawings

Provide T3 drawings for EF Telecommunications in accordance with EIA TIA/EIA-606-A that include telecommunications entrance facility plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard, and wall elevations. Drawings shall show layout of applicable equipment including building protector assembly, incoming cable connector blocks, patch panels and equipment spaces, and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings. Provide T3 drawings for EF Telecommunications as specified in the paragraph "Telecommunication Space Drawings" of Section 27 10 00, "Building Telecommunications Cabling Systems". The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with EIA TIA/EIA-758 within the past 3 years.

1.6.2.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or

more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Cable splicing and terminating personnel assigned to the installation of this system or any of its components shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications outside plant systems, including broadband cabling, and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitution for the telecommunications contractor's key personnel requires approval from the Contracting Officer.

1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with, EIA TIA/EIA-568-B.1, EIA TIA/EIA-568-B.2 and EIA TIA/EIA-568-B.3. In addition, cabling manufacturers shall have a minimum of 3 years experience in the manufacturing and factory testing of cabling which comply with ICEA S-87-640, ICEA S-98-688, and ICEA S-99-689.

1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the copper conductor and optical fiber cables, components, and accessories for approval by the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least 30 days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with EIA TIA/EIA-568-B.1 and RUS Bul 1753F-201. Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 2 years prior to bid opening. The 2 year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturer's catalogs, or brochures during the 2 year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the

Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in 5000 foot lenghts for 25, 50, or 100 pair configuraton and 1250 feet length for larger cables. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

1.8 MAINTENANCE

1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project.

Provide record documentation as specified in Section 27 10 00, "Building Telecommunications Cabling Systems".

Provide T5 drawings including documentation on cables and termination hardware in accordance with EIA TIA/EIA-606-A. T5 drawings shall include schedules to show information for cut-over and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in both hard copy format and on electronic media using Windows based computer cable management software. A licensed copy of the cable management software including documentation shall be provided. Update existing record documentation to reflect campus distribution T0 drawings and T3 drawing schedule information modified, deleted or added as a result of this installation. Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided in accordance with EIA TIA/EIA-606-A. The cable records shall include only the required data fields on the hard copy and the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with EIA TIA/EIA-606-A. Include manufacture date of cable with submittal.

b. Termination Hardware - Provide a record of installed patch panels, cross-connect points, campus distributor and terminating block arrangements and type in accordance with EIA TIA/EIA-606-A. Documentation shall include the required data fields in accordance with EIA TIA/EIA-606-A.

1.8.2 Spare Parts

In addition to the requirements of Section 01 78 23, "Operation and Maintenance Data", provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking. Spare parts shall be provided no later than the start of field testing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

2.2.1 Building Protector Assemblies

Building protector assembly shall be self-contained and have interconnecting hardware for connection to exterior cabling at full capacity. Provide manufacturers instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00, "Building Telecommunications Cabling System".

2.2.2 Protector Modules

Provide in accordance with UL 497 3-electrode gas tube or solid state type 5 pin rated for the application. Provide gas tube protection modules in accordance with RUS Bul 345-83 and shall be heavy duty, 400 volt where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current in accordance with NEMA C62.61. The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils in accordance with UL 497. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

Provide fiber optic cable terminations as specified in Section 27 10 00, "Building Telecommunications Cabling System".

2.2.4 Pathways

Underground applications for single buildings: provide a minimum of two (2) four inch ducts, one of which contains 2- three cell fabric inner ducts. The underground ducts must have 3" concrete encasing, 24 inches below grade minimum from the Telecommunications Entrance Facility to the maintenance hole that will be providing service to the building (Demarcation point). For campus distribution between maintenance holes ducts may need to be 5" or 6" to support larger cables also there will be no less that 4 and up to

50 ducts as needed for distribution to the area serviced. All new ducts will be plugged at both ends and visably marked or provided on area map with GPS coordinates.

For direct buried applications, provide a minimum of two (2) four inch ducts from the Telecommunications Entrance Facility to five feet outside the bldg, 24 inches below grade. The ducts will be plugged at both ends and clearly marked on outside end. For distribution to demarcation, between Hand Holes, and Riser points cables need to be 36" below grade with metal locating tape at 24" below grade. Cables need to be in HDDPE direct bored, concrete encased in conduit, or concrete encased split duct under all roadways and pavement. All new cables need to be provided on area map with GPS coordinates for riser points or hand holes.

Handholes and maintenance holes shall be traffic rated (MIN tier 15). Hand hole size min 4'x4'x4'. Maintenance hole size min 6'x7'x8'.

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Aerial Cable Closures

Provide cable closure assembly consisting of a frame with clamps, a lift-off polyethylene cover, cable nozzles, and drop wire rings. Closure shall be suitable for use on Figure 8 cables. Closures shall be free breathing and suitable for housing either straight-through or branch type splices of non-pressurized communications cables and shall be sized as indicated. The closure shall be constructed with ultraviolet resistant PVC.

NOTE: The installation of aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.

2.3.1.2 Underground Cable Closures

a. Aboveground. Provide aboveground closures constructed of not less than 14 gauge steel and acceptable pole or stake mounting in accordance with RUS 1755.910. Closures shall be sized and contain a marker as indicated. Covers shall be secured to prevent unauthorized entry. PVC type closures are to be used in beach areas. All pedestals shall contain a minimum 4 foot x 3/8 inch pigtailed ground rod.

b. Direct burial. Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity in the buried environment. Encapsulating compound shall be re-enterable and shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with RUS Bul 345-72.

c. In vault or manhole. Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound. Closure shall be of suitable thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be re-enterable and

shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with RUS Bul 345-72.

2.3.2 Fiber Optic Closures

2.3.2.1 Aerial

Provide aerial closure that is free breathing and suitable for housing splice organizer of non-pressurized cables. Closure shall be constructed from heavy PVC with ultraviolet resistance.

NOTE: The installation of aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.

2.3.2.2 Direct Burial

Provide buried closure suitable to house splice organizer in protective housing into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity, when metallic, in buried environment. Encapsulating compound shall be re-enterable and shall not alter chemical stability of the closure.

2.3.2.3 Vaults or Manholes

Provide underground closure suitable to house splice organizer in a protective housing into which can be poured an encapsulating compound. Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be re-enterable and shall not alter the chemical stability of the closure.

2.4 PAD MOUNTED CROSS-CONNECT TERMINAL CABINETS

Provide in accordance with RUS 1755.910 and the following:

a. Constructed of 14 gauge steel.

b. Equipped with a double set of hinged doors with closed-cell foam weather-stripping. Doors shall be locked and contain a marker as indicated.

c. Equipped with spool spindle bracket, mounting frames, binding post log, jumper instruction label and load coil mounting provisions.

d. Complete with cross connect modules to terminate number of pairs as indicated.

e. Sized as indicated.

2.5 CABLE SPLICES, AND CONNECTORS

2.5.1 Copper Cable Splices

Provide multi-pair, in-line fold back or single pair, in-line splices of a moisture resistant, three-wire insulation displacement connector held rigidly in place to assure maximum continuity in accordance with RUS Bul 1753F-401. Cables greater than 25 pairs shall be spliced using

multi-pair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable. Provide enough cable slack suitable for splicing operations, but in no case less than 10 feet.

2.5.2 Copper Cable Splice Connector

Provide splice connectors with a polycarbonate body and cap and a tin-plated brass contact element. Connector shall accommodate 19 to 26 AWG solid wire with a maximum insulation diameter of 1.65 mm (0.065 inch). Fill connector with sealant grease to make a moisture resistant connection, in accordance with RUS Bul 1753F-401.

2.5.3 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for fusion methods at locations shown on the construction drawings. The splice insertion loss shall be 0.3 dB maximum when measured in accordance with EIA TIA/EIA-455-59A using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 db max for single mode fiber when tested in accordance with EIA TIA/EIA-455-107A. Physically protect each fiber optic splice by a splice kit specially designed for the splice. Provide enough cable slack suitable for splicing operations, but in no case less than 30 feet.

2.5.4 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly fashion. Splice organizer shall allow for a minimum of 1 m (3 feet) of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

2.5.5 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor in accordance with RUS Bul 345-65.

2.6 CONDUIT

Provide conduit as specified in Section 33 71 02, "Underground Transmission and Distribution."

2.7 PLASTIC INSULATING TAPE

UL 510.

2.8 WIRE AND CABLE

2.8.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into

compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs). Copper conductors shall conform to the following: All copper conductor cable from 6 to 1800 pair shall be PE-39 type, 1801-2400 pair shall be PE-89.

NOTE: 26 AWG is not used on Camp Lejeune.

2.8.1.1 Underground

Provide filled cable (type PE-39) meeting the requirements of ICEA S-99-689 and RUS 1755.390. Provide enough cable slack suitable for splicing operations, but in no case less than 10 feet.

2.8.1.2 Aerial

Provide filled cable meeting the requirements of ICEA S-99-689, ICEA S-98-688, and RUS 1755.390 except that it shall be suitable for aerial installation and shall be Figure 8 distribution wire with 26,700 N (6,000 pound) Class A galvanized steel or 26,700 N (6,000 pound) aluminum-clad steel strand.

NOTE: The installation of aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.

2.8.1.2 Screen

Provide screen-compartmental core cable filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.390.

2.8.2 Fiber Optic Cable

Provide single-mode, 8/125-um, 0.10 aperture 1310 nm fiber optic cable in accordance with EIA TIA/EIA-492CAAA, EIA TIA/EIA-472D000-A, and ICEA S-87-640 including any special requirements made necessary by a specialized design. Provide 12 optical fibers as indicated. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with EIA TIA/EIA-598-B

2.8.2.1 Strength Members

Provide central/non-central, and non-metallic/metallic strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

2.8.2.2 Shielding or Other Metallic Covering

Provide bare aluminum or coated aluminum, single tape covering or shield in accordance with ICEA S-87-640.

2.8.2.3 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

2.8.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with RUS 1755.200, TIA J-STD-607-A, IEEE C2, and NFPA 70. Solid bare copper wire meeting the requirements of ASTM B 1 for sizes number 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B 8, for sizes number 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

2.9 T-SPAN LINE TREATMENT REPEATERS

Provide as indicated. Repeaters shall be pedestal mounted with pressurized housings, sized as indicated and shall meet the requirements of RUS Bul 345-50.

2.10 POLES AND HARDWARE

Provide poles and hardware as specified in Section 33 71 01, "Overhead Transmission and Distribution".

2.11 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be stainless steel or polyethylene and labeled in accordance with EIA TIA/EIA-606-A. Handwritten labeling is unacceptable.

2.11.1 Stainless Steel

Provide stainless steel, cable tags 41.25 mm (1 5/8 inches) in diameter 1.58 mm (1/16 inch) thick minimum, and circular in shape. Tags shall be die stamped with numbers, letters, and symbols not less than 6.35 mm (0.25 inch) high and approximately 0.38 mm (0.015 inch) deep in normal block style.

2.11.2 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 22.4 MPa (3250 pounds per square inch); and that are two millimeter (0.08 inch) thick minimum, non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C (170 degrees F). Provide 1.3 mm (0.05 inch) minimum thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 778.75 N (175 pounds). The cable tags shall have black block letters, numbers, and symbols 25 mm (one inch) high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of cable tag orientation.

2.12 BURIED WARNING AND IDENTIFICATION TAPE

Provide fiber optic media marking and protection in accordance with EIA TIA/EIA-590-A. Provide color, type and depth of tape as specified in paragraph "Buried Warning and Identification Tape" in Section 31 00 00,

"Earthwork".

2.13 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS 1755.200. Braid shall be made from flat tin-plated copper.

2.14 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.15 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with ASTM D 709 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm (0.125 inch) thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm (one by 2.5 inches). Lettering shall be a minimum of 6.35 mm (0.25 inch) high, and of normal block style.

2.16 TESTS, INSPECTIONS, AND VERIFICATIONS

2.16.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with EIA TIA/EIA-568-B.1 and EIA TIA/EIA-568-B.3. Use EIA TIA/EIA-526-7 for single mode optic fiber and EIA TIA/EIA-526-14A Method B for multi mode optic fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in

determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

3.1.3 Direct Burial System

Installation shall be in accordance with RUS Bul 1751F-640. Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment. Provide a minimum cable cover of 610 mm (24 inches) below finished grade. Trenches shall be not less than 155 mm (6 inches) wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than 915 mm (36 inches). Where two or more cables are laid parallel in the same trench, space laterally at least 78 mm (3 inches) apart. When rock is encountered, remove it to a depth of at least 78 mm (3 inches) below the cable and fill the space with sand or clean earth, free from particles larger than 6 mm (1/4 inch). Do not unreel and pull cables into the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in paragraph "Buried Warning and Identification Tape" in Section 31 00 00, "Earthwork".

3.1.3.1 Cable Placement

a. Prior to design and installation of any copper or optical fiber cable systems, cable routes and pathways must be approved by the Base Telephone Officer.

b. Separate cables crossing other cables or metal piping from the other cables or pipe by not less than 78 mm (3 inches) of well tamped earth. Do not install circuits for communications under or above traffic signal loops.

c. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.

d. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

e. Leave a horizontal slack of approximately 3048 mm (10 feet) in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought above ground, leave additional slack to make necessary connections.

3.1.3.2 Identification Markers

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete,

approximately 508 mm (20 inches) square by 155 mm (6 inches) thick.

3.1.3.3 Backfill for Rocky Soil

When placing cable in a trench in rocky soil, the cable shall be cushioned by a fill of sand or selected soil at least 53 mm (2 inches) thick on the floor of the trench before placing the cable or wire. The backfill for at least 103 mm (4 inches) above the wire or cable shall be free from stones, rocks, or other hard or sharp materials which might damage the cable or wire. If the buried cable is placed less than 610 mm (24 inches) in depth, a protective cover of concrete shall be used.

3.1.4 Cable Protection

Provide direct burial cable protection in accordance with NFPA 70 and as specified in Section 33 71 02, "Understand Transmission and Distribution". Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be PVC coated and shall extend from the first coupling or fitting outside either side of the concrete minimum of 155 mm per 305 mm (6 inches per 12 inches) burial depth beyond the edge of the surface where cable protection is required; all conduits shall be sealed on each end. Where additional protection is required, cable may be placed in galvanized iron pipe (GIP) sized on a maximum fill of 40% of cross-sectional area, or in concrete encased 103 mm (4 inches) PVC pipe. Conduit may be installed by jacking or trenching. Trenches shall be backfilled with earth and mechanically tamped at 155 mm (6 inches) lift so that the earth is restored to the same density, grade and vegetation as adjacent undisturbed material.

3.1.4.1 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.5 Underground Duct

Provide underground duct and connections to existing manholes, handholes, as specified in Section 33 71 02, "Underground Transmission and Distribution" with any additional requirements as specified herein.

3.1.6 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 71 02, "Underground Transmission and Distribution".

3.1.7 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00, "Firestopping".

3.1.8 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material

before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer or Base Telephone Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.8.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.8.2 Pulling Eyes

Equip cables 32 mm (1.25 inches) in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 32 mm (1.25 inches) with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 19 mm (3/4 inch) links between pulling-in eyes or grips and pulling strand.

3.1.8.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 1220 mm (4 feet). Install cable or cables in corresponding ducts entering and exiting the manholes. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.1.9 Aerial Cable Installation

Pole installation shall be as specified in Section 33 71 01, "Overhead Transmission and Distribution". Where physical obstructions make it necessary to pull distribution wire along the line from a stationary reel, use cable stringing blocks to support wire during placing and tensioning operations. Do not place ladders, cable coils, and other equipment on or against the distribution wire. Wire shall be sagged in accordance with the

data shown. Protect cable installed outside of building less than 2.5 meters (8 feet) above finished grade against physical damage.

NOTE: The installation of aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.

3.1.9.1 Figure 8 Distribution Wire

Perform spiraling of the wire within 24 hours of the tensioning operation. Perform spiraling operations at alternate poles with the approximate length of the spiral being 4575 mm (15 feet). Do not remove insulation from support members except at bonding and grounding points and at points where ends of support members are terminated in splicing and dead-end devices. Ground the support wire at poles to the pole ground.

3.1.9.2 Suspension Strand

Place suspension strand as indicated. Tension in accordance with the data indicated. When tensioning strand, loosen cable suspension clamps enough to allow free movement of the strand. Place suspension strand on the road side of the pole line. In tangent construction, point the lip of the suspension strand clamp toward the pole. At angles in the line, point the suspension strand clamp lip away from the load. In level construction place the suspension strand clamp in such a manner that it will hold the strand below the through-bolt. At points where there is an up-pull on the strand, place clamp so that it will support strand above the through-bolt. Make suspension strand electrically continuous throughout its entire length, bond to other bare cables suspension strands and connect to pole ground at each pole.

3.1.9.3 Aerial Cable

Keep cable ends sealed at all times using cable end caps. Take cable from reel only as it is placed. During placing operations, do not bend cables in a radius less than 10 times the outside diameter of cable. Place temporary supports sufficiently close together and properly tension the cable where necessary to prevent excessive bending. In those instances where spiraling of cabling is involved, accomplish mounting of enclosures for purposes of loading, splicing, and distribution after the spiraling operation has been completed.

NOTE: The installation of aerial cabling aboard Marine Corps Base, Camp Lejeune and Marine Corps Air Station, New River is not authorized.

3.1.10 Cable Splicing

3.1.10.1 Copper Conductor Splices

Perform splicing in accordance with requirements of RUS Bul 1753F-401 except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

3.1.10.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.3 dB for fusion splices.

3.1.11 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meets the requirements of RUS Bul 1751F-815.

3.1.12 Grounding

Provide grounding and bonding in accordance with RUS 1755.200, TIA J-STD-607-A, IEEE C2, and NFPA 70. Ground exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.12.1 Telecommunications Main Ground Bar (TMGB)

The TMGB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a TMGB for connection point for cable stub shields to connector blocks and CD protector assemblies as specified in Section 26 51 00 "Interior Lighting". The TMGB will at a minimum be 4 inches by 10 inches by 1/4 inch.

3.1.12.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground shields of incoming cables in the EF Telecommunications to the TMGB.

3.1.12.3 Campus Distributor Grounding

a. Protection assemblies: Mount CD protector assemblies directly on the telecommunications backboard. Connect assemblies mounted on each vertical frame with number 6 AWG copper conductor to provide a low resistance path to TMGB.

b. TMGB connection: Connect TMGB to TGB with copper conductor with a total resistance of less than 0.01 ohms.

3.1.13 Cut-Over

All necessary transfers and cut-overs shall be accomplished by the telecommunications contractor.

3.2 LABELING

3.2.1 Labels

Provide labeling for new cabling and termination hardware located within the facility in accordance with EIA TIA/EIA-606-A. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using either hermal ink transfer process or laser printer.

3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice. Tag only new wire and cable provided by this contract. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of telecommunications cable tag identifiers shall be in accordance with

EIA TIA/EIA-606-A. Tag legend shall be as indicated. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with EIA TIA/EIA-606-A.

3.3 FIELD APPLIED PAINTING

Provide ferrous metallic enclosure finishes in accordance with the following procedures. Ensure that surfaces are dry and clean when the coating is applied. Coat joints and crevices. Prior to assembly, paint surfaces which will be concealed or inaccessible after assembly. Apply primer and finish coat in accordance with the manufacturer's recommendations. Provide ferrous metallic enclosure finishes as specified in Section 09 90 00, "Paints and Coatings"

3.3.1 Cleaning

Clean surfaces in accordance with SSPC SP 6.

3.3.2 Priming

Prime with a two component polyamide epoxy primer which has a bisphenol-A base, a minimum of 60 percent solids by volume, and an ability to build up a minimum dry film thickness on a vertical surface of 0.127 mm (5.0 mils). Apply in two coats to a total dry film thickness of 0.127 to 0.2 mm (5 to 8 mils).

3.3.3 Finish Coat

Finish with a two component urethane consisting of saturated polyester polyol resin mixed with aliphatic isocyanate which has a minimum of 50 percent solids by volume. Apply to a minimum dry film thickness of 0.05 to 0.076 mm (2 to 3 mils). Color shall be the manufacturer's standard.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.5.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed

from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.5.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.5.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.5.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.5.2 Acceptance Tests

Perform acceptance testing in accordance with RUS Bul 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

3.5.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with EIA TIA/EIA-758:

a. Wire map (pin to pin continuity)

b. Continuity to remote end

c. Crossed pairs

d. Reversed pairs

e. Split pairs

f. Shorts between two or more conductors

g. Grounded pairs.

3.5.2.2 Fiber Optic Cable

Test fiber optic cable in accordance with EIA TIA/EIA-455-B and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multimode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 1000 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with EIA TIA/EIA-526-7 for single-mode fiber and EIA TIA/EIA-526-14A for multimode fiber. Splice losses shall not exceed 0.3 db.

b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 850 and 1300 for 62.5 multi-mode fiber and 1310 and 1550 for single mode nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with EIA TIA/EIA-455-46A for multimode and EIA TIA/EIA-526-7 for single-mode fiber optic cables. The measurement method shall be in accordance with EIA TIA/EIA-455-61A. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber. Attenuation losses shall not exceed 5.0 db/km at 850 nm and 1.5 db/km at 1300 nm for multimode fiber.

c. Bandwidth Test: The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with EIA TIA/EIA-455-204.

3.5.3 Soil Density Tests

a. Determine soil-density relationships for compaction of backfill material in accordance with ASTM D 1557, Method D.

b. Determine soil-density relationships as specified for soil tests in Section 31 00 00, "Earthwork".

-- End of Section --

SECTION 41 65 20

AUTOMATIC PUMP CONTROLS

01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

1.2 RELATED REQUIREMENTS

Section 26 00 00, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.3 AUTOMATIC PUMP CONTROL CRITERIA

Provide an automatic pump control system as described herein and as shown. Automatic control of pumps shall be based on the level of the wet well. Interface the level signal and all other required inputs and outputs to the control panel and to the telemetry and monitoring system.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-02 Shop Drawings

Control relay cabinet

Certified general arrangement, size, and location of electrical interface points, and detailed elementary, schematic wiring, and interconection diagrams of components. Show all logic that shall be implemented in ladder diagram format, fully annotated, cross-referenced and showing inter-relationship of all equipment.

SD-03 Product Data

Control relay cabinet

Multi-position rotary switches

Audio visual alarm

Relays

Float switch assembly

SD-06 Test Reports

Acceptance Tests

SD-07 Certificates

Control relay cabinet

SD-10 Operation and Maintenance Data

Control relay cabinet, Data Package 5

PART 2 PRODUCTS

2.1 GENERAL

Equipment and materials furnished under this specification shall be products of manufacturers regularly engaged in the production of such equipment and of the manufacturer's latest design. All items of the same type and ratings shall be identical. The entire system shall be a coordinated and integrated design of a single supplier. The Contractor shall show satisfactory evidence that the system supplier maintains a service department equipped to provide service and replacement parts for the equipment provided. Furthermore, evidence shall be shown that the system supplier is fully qualified to perform maintenance of the system after the warranty period.

2.2 CONTROL RELAY CABINET

Provide a control relay cabinet as shown on the drawings. The cabinet shall contain all switches, indicators, relays, and all other equipment as necessary to provide a fully functional control and telemetry system as specified. Color code internal wiring in accordance with furnished diagrams. Permanently and visibly identify switches, control relays, and other components.

2.2.1 Indicators

Provide yoke-mounted, cadelabra-base sockets rated 125 volts and fitted with glass or plastic jewels and clear 3-watt lamp in each indicator. They shall have a screw or plug in base to facilitate easy replacement. Provide legend plates with wording as indicated on the drawings.

2.2.2 Multi-Position Rotary Switches

Provide multi-position rotary switches with voltage and ampere ratings, and contract arrangements suitable for the intended use. Contacts shall be non-shorting and rated in accordance with NEMA ICS 2.125. Provide legend plates with wording as indicated on the drawings.

2.2.3 Audio Visual Alarm

Provide an audio/visual alarm mounted on the outside of the lift station.

The horn shall be rated at 90-100 dB SPL at 4-feet on axis with an output frequency between 1000 and 2000 hz built per NEMA ICS 2.212, as indicated and necessary. Provide a flashing red light with long life bulb in guarded enclosure.

2.2.4 Relays

Provide 600 volt electromechanical cartridge-type control relays, built in accordance with industry standard practices as outlined in NEMA ICS 2.212. Control relays shall be UL listed and all accessories shall be UL component recognized.

2.2.4.1 Contacts

Per NEMA A 600 with 10 ampere rating

a. Relays shall incorporate cartridge-type contact assemblies and allow individual removal or replacement of the cartridge without disturbing adjacent cartridges, wiring or relays.

b. Contact cartridges shall be convertible from the normally closed mode to the normally open mode and vice versa without removal of terminal/cartridge screws or wiring. The contact cartridges shall have clearly visible normally open and normally closed contact symbols to indicate contact status in the installed position.

c. A basic relay shall have room for up to 4 plug-in convertible contact cartridges. Adder decks shall be available to expand a 4 pole relay up to 12 poles. The same adder deck shall be used for both the middle and upper decks.

d. The same contact cartridge shall fit all relay pole locations and accessories. A dummy cartridge shall not be required in any unused position.

e. Relays shall incorporate a common mechanical-tie between contact cartridges and the armature.

f. A significant degree of non-overlap between normally open and normally closed contacts shall exist under normal operating conditions.

g. Overlapping contact cartridges shall be provided where overlapping contacts are indicated.

2.2.4.2 Coils

a. Coils shall be field replaceable and rated 120 VAC.

b. Coils shall be suitable for use with any permissible number or arrangement of relay contacts and/or accessories.

2.2.4.3 Manual Operation

a. Each relay and accessory attachment shall have provision for manual operation.

b. A manual test tool shall be available for use with the basic control relay.

2.2.4.4 Installation and Wiring

a. Self-lifting pressure wire connectors with captive terminal screws shall be used on all terminals.

b. Terminals shall be extended beyond the wire clamp to act as a guide during wiring.

c. The relay shall be designed for straight through wiring.

2.2.4.5 Mounting

a. All relays shall have the same mounting dimensions.

2.2.5 Enclosure for Automatic Pump Controls

NEMA ICS 6; provide in NEMA 3R, 4X-Stainless Sette, 4X-Fiberglass enclosure with 3-point latch and padlock hasp. Access to controls including resetting shall be internal and not accessible from the exterior of the enclosure. Mount manual-operated devices and indicating devices on interior swing panel; secure swing panel with quarter-turn latches.

2.3 FLOAT SWITCH ASSEMBLY

One high level alarm float switch, one per pump high water level pump on float switch, one pumps off float switch, and one low water level alarm float switch shall be provided. Floats, supports, and alarm shall be provided. Metal parts, if used, shall be of stainless steel or equivalent corrosion resistant material. The pump low and high level switches shall be connected such that one pump turns on at normal high level switches and off a low level. The second high level switch shall turn on the second pump, etc. All pumps shall run until turned off by the low level switch. The high level alarm switch shall actuate the high level alarm.

2.3.1 Float Switch

The device shall be a direct acting float switch consisting of a normally-open mercury switch enclosed in a float. Switches shall be epoxy resin potted in a solid polyurethane or polypropelene float. floats shall be attached to the support pole using reinforcing sleeve and plastic self-locking tie, support pole shall be 1 5/8-inch stainless steel electrical channel. Mercury glass tube switch shall be normally open, double pole and rated 2 amps at 120 VAC. A junction box shall be provided to connect the float assembly. The box shall have a gasketed cover with a tapped float fitting and conduit entrance pipe threaded opening. The floats shall be mounted at fixed elevations as directed by the Government. When the liquid level being sensed rises or falls past the float, the floats shall tilt and operate their switches.

2.4 WIRE AND CABLE

Provide all wiring required for a complete and operational system and in accordance with manufacturer's recommendations. Electrical work shall be in accordance with Section 26 00 00, "Basic Electrical Materials and Methods," and Section 26 20 00, "Interior Distribution System."

PART 3 EXECUTION

3.1 GENERAL

Install equipment so as to provide the minimum service clearances as recommended by the manufacturer and to permit easy access from platforms or work surfaces. Install guards and protective shielding over all hot surfaces and high voltage electrical devices. Equipment shall be installed so as not to hinder access to existing equipment or building components.

3.2 ACCEPTANCE TESTS

After the system has been completely installed. The Contractor shall perform a system acceptance test. The level control and alarm setpoint shall be verified to within +/- 0.2 feet. The system shall perform all control of pumps and alarms as required in the sequence of operation and indication in the wiring diagrams. All control panel functions, alarms and telemetry shall be demonstrated to operate as specified. The Contractor shall furnish all instruments, connecting devices, tools, and personnel necessary to perform the testing. Failure to pass the acceptance test shall required the Contractor to make corrections or repairs and begin a new test. The system shall not be accepted by the Government unless it operates within the above guidelines. A proposed test schedule shall be submitted to the Contracting Officer at least 14 days prior to proposed testing for approval.

-- End of Section --