Project Number: 1032443

A/E Contract Number:
N69450-11-D-0071

Delivery Order Number: 0022

SPECIFICATIONS

N.A.S Corpus Christi Airfield Repair

At the

N.A.S. Corpus Christi
Corpus Christi, TX

PREPARED BY:

Leidos Engineering, LLC
One West 3rd Street, Suite 200
Tulsa, OK 74103

Delta Airport Consultants, Inc
9711 Farrar Court, Suite 100
Richmond, VA 23236

Architectural: Thomra Russell, Leidos
Civil: John Bean, Leidos
Jon McCalmont, Delta
Structural: David Swyden, Leidos

Mechanical: Jason Watkins, Leidos
Electrical: David Burgess, Delta
Jose Sposito, Leidos

Submitted by: John Bean, Leidos

Date: 11/6/2015

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

ARCHITECTURAL ENGINEER

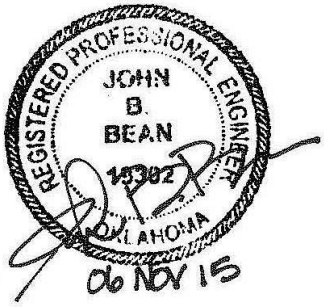
Tomra Russell, Leidos

MECHANICAL ENGINEER

Jason Watkins, Leidos

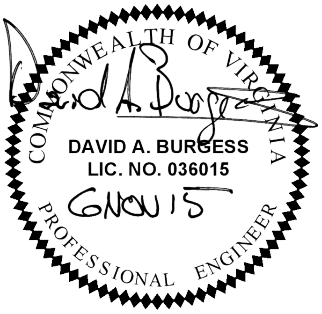
CIVIL ENGINEER

John Bean, Leidos



ELECTRICAL ENGINEER

David Burgess, Delta



CIVIL ENGINEER

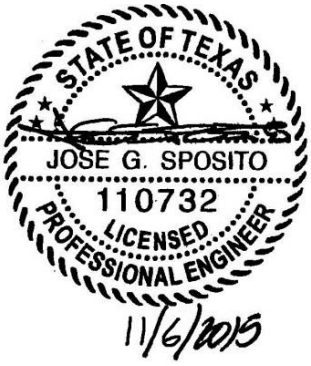
Jon McCalmont, Delta

STRUCTURAL ENGINEER

David Swyden, Leidos

ELECTRICAL ENGINEER

Jose Sposito, Ledios



END OF SECTION 000107

THIS PAGE INTENTIONALLY LEFT BLANK

PROJECT TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

01 11 00.00 25 SUMMARY OF WORK
01 14 00.00 25 WORK RESTRICTIONS
01 20 00.00 25 PRICE AND PAYMENT PROCEDURES
01 30 00.00 25 ADMINISTRATIVE REQUIREMENTS
01 32 17.00 25 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS)
01 33 00 SUBMITTAL PROCEDURES
01 35 13.00 25 SPECIAL PROJECT PROCEDURES
01 35 26.00 25 GOVERNMENTAL SAFETY REQUIREMENTS
01 35 40.00 20 ENVIRONMENTAL MANAGEMENT
01 42 00 SOURCES FOR REFERENCE PUBLICATIONS
01 45 00.00 25 QUALITY CONTROL
01 50 00.00 25 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
01 57 16.00 25 TEMPORARY PEST CONTROL
01 57 19.00 25 TEMPORARY ENVIRONMENTAL CONTROLS
01 58 00.00 25 PROJECT IDENTIFICATION
01 74 19.00 25 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01 75 00.00 25 STARTING AND ADJUSTING
01 78 00.00 25 CLOSEOUT SUBMITTALS
01 78 23.00 25 OPERATION AND MAINTENANCE DATA
01 78 24.00 25 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI)

DIVISION 02 - EXISTING CONDITIONS

02 41 00 DEMOLITION

DIVISION 03 - CONCRETE

03 30 00 CAST-IN-PLACE CONCRETE
03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE FOR BUILDING STRUCTURES

DIVISION 05 - METALS

05 12 00 STRUCTURAL STEEL
05 21 19 OPEN WEB STEEL JOIST FRAMING
05 30 00 STEEL DECKS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 13 33 PIER TIMBERWORK

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 21 23 LOOSE FILL THERMAL INSULATION
07 22 00 ROOF AND DECK INSULATION
07 41 13 METAL ROOF PANELS
07 60 00 FLASHING AND SHEET METAL
07 81 00 SPRAY-APPLIED FIREPROOFING
07 92 00 JOINT SEALANTS

DIVISION 08 - OPENINGS

08 11 13 STEEL DOORS AND FRAMES
08 71 00 DOOR HARDWARE

DIVISION 09 - FINISHES

09 90 00 PAINTS AND COATINGS

DIVISION 10 - SPECIALTIES

10 44 16 FIRE EXTINGUISHERS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS
23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS
23 05 15 COMMON PIPING FOR HVAC
23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS
23 08 00.00 10 COMMISSIONING OF HVAC SYSTEMS
23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS
23 23 00 REFRIGERANT PIPING
23 31 13 METAL DUCTS
23 37 13.00 40 DIFFUSERS, REGISTERS, AND GRILLS
23 82 02.00 10 UNITARY HEATING AND COOLING EQUIPMENT

DIVISION 26 - ELECTRICAL

26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS
26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS
26 20 00 INTERIOR DISTRIBUTION SYSTEM
26 23 00 SWITCHBOARDS AND SWITCHGEAR
26 27 14.00 20 ELECTRICITY METERING
26 36 23.00 20 AUTOMATIC TRANSFER SWITCHES
26 51 00 INTERIOR LIGHTING

DIVISION 31 - EARTHWORK

31 00 00 EARTHWORK
31 10 00 CLEARING
31 23 00.00 20 EXCAVATION AND FILL

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 01 11.51 RUBBER AND PAINT REMOVAL FROM AIRFIELD PAVEMENTS
32 01 16.17 COLD MILLING OF BITUMINOUS PAVEMENTS
32 01 17.16 SEALING OF CRACKS IN BITUMINOUS PAVEMENTS
32 01 19.61 RESEALING OF JOINTS IN RIGID PAVEMENT
32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN AND REPAIRED CRACKS RIGID PAVEMENTS
32 01 29.61 PARTIAL DEPTH PATCHING OF RIGID PAVING
32 11 23 AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE
32 12 10 BITUMINOUS TACK AND PRIME COATS
32 12 15.13 HOT-MIX ASPHALT AIRFIELD PAVING
32 12 36.19 COAL TAR SEAL COAT WITH UNVULCANIZED RUBBER
32 13 11 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS
32 17 23.00 20 PAVEMENT MARKINGS
32 92 23 SODDING

DIVISION 33 - UTILITIES

33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION

DIVISION 34 - TRANSPORTATION

34 43 00.00 20 AIRFIELD LIGHTING

-- End of Project Table of Contents --

SECTION 01 11 00.00 25

SUMMARY OF WORK
12/14
NAVFAC SE VERSION

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.

ASTM INTERNATIONAL (ASTM)

ASTM E2114	(2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

1.2 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E2114, Section01 57 19.00 25 TEMPORARY ENVIRONMENTAL CONTROLS, and as specified.

a. "Environmentally preferable products" have a lesser or reduced effect on the environment in comparison to conventional products and services. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product.

b. "Indoor environmental quality" is the physical characteristics of the building interior that impact occupants, including air quality, illumination, acoustics, occupant control, thermal comfort, daylighting, and views.

c. "Operational performance" is the functional behavior of the building as a whole or of the building components.

d. "Sustainability" is the balance of environmental, economic, and societal considerations.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

1.3.1 Project Description

The scope of this project will be identified under CLIN Identification number.

(CLIN No.001-Base CLIN) is identified as: 1) Airfield Lighting Vault package, 2) Runway 13R-31L Approach Lights package, 3) Main Parking Apron Package and 4) Taxiway "E" package.

(1) The Airfield Lighting Vault package will involve the expansion of the airfield lighting vault. The existing airfield lighting infrastructure will

be replaced and the existing emergency generator will be retrofitted with a new muffler system. New electrical conduit and cabling will be installed from the source of power (transformer) to the building and from the building to a point of demarcation.

(2) The Runway 13R-31L Approach light package will include the complete removal of the wooden pier structure with the exception of the piles. The piles will be re-used for the re-installation of a new wooden (pressure treated) pier structure. The project will also include the removal of the existing electrical and lighting infrastructure on the pier and in the paved 13R-31L paved overrun, the rehabilitation of the access to the pier, the relocation of the existing PARs antennae and the repair of the perimeter security fence and gate.

LED lighting will be installed throughout the overrun and new lighting will be installed on each of the piers. The lighting on the piers will be installed on a single frangible fiberglass mast in order to minimize the obstruction footprint of the system. A new concrete ramp will be installed from the edge of the access drive to the entrance of the pier in order to facilitate the movement of equipment used to repair or upgrade the lighting system. To enhance security the gate and fence will be modified to a smaller 4' manway.

(3) The main parking apron project will facilitate the relocation of Taxiway "C" from between the parked aircraft and the hangers to the airfield side of the apron. In addition, deteriorated pavement (both PCC and ACC) will be repaired. The repair work will also include joint rehabilitation and crack sealing where identified. The existing striping and markings will be removed in anticipation of the revised parking layout. Where necessary additional grounding points and aircraft mooring points will be installed. Upon completion of the pavement repairs and marking removal, ACC paved areas will be seal coated and new striping and markings will be installed throughout the parking apron and Taxiway "C."

(4) Improvements to Taxiway "E" include the demolition and removal of excess pavement, the re-establishment of the vegetative surface where pavement is removed, crack sealing and ACC pavement repair, the demolition of existing striping, markings and lighting. Upon completion of the repair work, the taxiway will be seal coated with new striping and markings installed. This project will also include the upgrading of the airfield lighting system to LED fixtures.

1.3.2 Location

The work shall be located at Truax Field, located in Corpus Christi approximately as indicated. The exact location will be shown by the Contracting Officer.

1.4 PROJECT ENVIRONMENTAL GOALS

Contractor shall distribute copies of the Environmental Goals to each subcontractor and the Contracting Officer. The overall goal for design, construction, and operation is to produce a building that meets the functional program needs and incorporates the principles of sustainability. Specifically:

a. Preserve and restore the site ecosystem and biodiversity; avoid site

degradation and erosion. Minimize offsite environmental impact.

b. Use the minimum amount of energy, water, and materials feasible to meet the design intent. Select energy and water efficient equipment and strategies.

c. Use environmentally preferable products and decrease toxicity level of materials used.

d. Use renewable energy and material resources.

e. Optimize operational performance (through commissioning efforts) in order to ensure energy efficient equipment operates as intended. Consider the durability, maintainability, and flexibility of building systems.

f. Manage construction site and storage of materials to ensure no negative impact on the indoor environmental quality of the building.

g. Reduce construction waste through reuse, recycling, and supplier take-back.

1.5 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.

1.6 LOCATION OF UNDERGROUND UTILITIES

Obtain digging permits prior to start of excavation by contacting the Contracting Officer 15 calendar days in advance. 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 to be specified or removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.6.1 Notification Prior to Excavation

Notify the Contracting Officer at least 48 hours prior to starting excavation work.

1.7 SALVAGE MATERIAL AND EQUIPMENT

Items designated by the Contracting Officer to be salvaged shall remain the property of the Government.

The salvaged property, if applicable, shall be segregated, itemized, delivered, and off-loaded as directed by the Contracting Officer or as shown on contract drawings at the Government designated storage area located within 5 miles of the construction site.

Contractor shall maintain property control records for material or equipment designated as salvage. Contractor's system of property control may be used if approved by the Contracting Officer. Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 14 00.00 25

WORK RESTRICTIONS
12/14
NAVFAC SE VERSION

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of Contact Personnel; G

1.2 SPECIAL SCHEDULING REQUIREMENTS

a. Have materials, equipment, and personnel required to perform the work at the site prior to the commencement of the work.

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

c. Permission to interrupt any Activity roads, and/or utility service must be requested in writing a minimum of 3 calendar days prior to the desired date of interruption.

d. 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.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 Activity Regulations

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. Mark Contractor equipment for identification.

1.3.1.1 Subcontractors and Personnel Contacts

Provide 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.

1.3.1.2 Identification Badges and Installation Access

RAPID Gate: All contractor and subcontractor personnel shall obtain a

RAPID Gate pass to gain access to NAS Corpus Christi. Please allow three days for processing of all RAPID Gate applications. See http://www.rapidgate.com for additional information and costs. Costs incurred to obtain base access credentials are not directly reimbursable. No equitable adjustment in contract cost/price or schedule shall be allowed on account of the contractor participating in any program to obtain installation access.

Flight Line Pass: All contractor and subcontractor personnel working on airfield or flight line shall obtain flight a line pass. The flight line pass is offered at no costs to the contractor, but requires up to three days to process. Once the individual's application is processed, he/she shall proceed to the pass and tag office to have the flight line pass issued. Flight line passes are the property of the Government and must be returned upon completion of the project. Final payment will not be made until all cards are returned.

Airfield Vehicle Operators License: For projects located on the flight line or airfield, contractor or subcontractor personnel operating vehicles must also obtain one of two levels of licenses: (1) the Area 1 license (controlled movement areas), or (2) the Area 2 (aprons, non-runway/taxiway area). This license is required so ensure that all drivers are familiar with the airfield, its safety rules and radio protocols when operating vehicles where aircraft are present. The license must be obtained before the flight line pass. The license must be presented when obtaining the flight line pass in order to properly code the flight line pass to allow the driver to pass through the airfield access gate. Licenses are offered at no cost to the contractor.

Area 2 License - Area 2 includes all parking aprons, hangars, and associated facilities. To obtain an Area 2 license, vehicle operators must attend a one-hour class conducted on Tuesdays.

Area 1 License - Area 1 includes all runways, taxiways, and the perimeter road. To operate a vehicle in Area 1, the driver must attend an 8-hour class that is offered on Thursdays and continues into the next day(s). To obtain an Area 1 license, the operator must attend the class, pass a written test, and complete a day and night time practical test. An Area 1 license enables the driver the ability to drive on the entirety of the airfield, but the Area 2 license does not grant access to drive beyond the aprons.

Material deliveries: Material delivery trucks do not necessarily require RAPID Gate passes, flight line passes, or ramp passes. However, any material delivery driver that does not have a RAPID Gate pass must be escorted by Government personnel. To properly plan for Government escort availability, three (3) working days' notice is required for all material deliveries. Any material delivery driver that possesses a RAPID Gate pass does not require Government escort or advance notification unless the material is to be delivered on the flight line or airfield.

Time-Sensitive Material Deliveries: Time-sensitive material deliveries such as asphalt or concrete require pre-arrangement by NAS Security personnel to ensure expedited access at the entrance gate. Seven (7) calendar days' notice is required for time-sensitive material.

1.3.1.3 No Smoking Policy

Smoking is prohibited within and outside of all buildings on installation,

except in designated smoking areas. This applies to existing buildings, buildings under construction and buildings under renovation. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Contracting Officer will identify designated smoking areas.

1.3.2 Working Hours

The regular working hours will consist of two (2) 8 hour shifts, between 0600 a.m. and 2200 p.m., Monday through Friday and on weekends, excluding Government holidays. The Contractor shall not work the two (2) days at Thanksgiving (Thursday and Friday) and the 10 days at Christmas and New Year's (December 24th through January 2nd) without the written approval of the Contracting Officer. To secure approval to work during the holiday periods, contractor shall make application 15 calendar days prior to proposal. Approval may be declined by the contracting officer for any reason including lack of government personnel available during that period. The Contractor is not required to work two (2) 8 hour shifts. The Contractor can work his preferred schedule within the 16 hour window. See the project phasing sheets for special deviation from the regular hours. All working hours shall be coordinated with the Contracting Officer and the Airfield Operations Staff.

1.3.3 Work Outside Regular Hours

Work outside the indicated working hours requires Contracting Officer approval. Make application 15 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside regular hours. During periods of darkness, the different parts of the work must be lighted in a manner approved by the Contracting Officer. All shall be coordinated with the Contracting Officer and the Airfield Operations Staff.

1.3.4 Exclusionary Period

No work may be performed during the period the second or third week of April 2017 for the Air Show to be held at NAS Corpus Christi. For the Air Show, Runway 13R/31L, and Taxiway Y shall be fully operational. This period of time shall be inclusive, without prior written approval of the Contracting Officer. This period has not been considered in computing the time allowed for the performance of this contract.

1.3.5 Occupied and Existing Building

In addition to the airfield work, the Contractor shall be working in the existing Airfield Lighting Vault which is operational and occupied. Do not enter the Vaults without prior approval of the Contracting Officer.

The existing vaults and it's contents must 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 adjacent areas during the construction period.

Leave attached equipment in place, and protect against damage, or

temporarily disconnect, relocate, protect, and reinstall at the completion of the work.

1.3.6 Utility Cutovers and Interruptions

a. All utility cutovers and interruptions shall be coordinated with the Contracting Officer and the Airfield Operations Staff.

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 CCTV are considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

1.4 Airfield Communications

The Contractor shall provide personnel to serve as radio equipped driver escorts and crossing guards at haul roads that cross active taxiways. All airfield drivers and crossing guards shall be trained in the use of airfield radios and communication with Air Traffic Control (ATC). Training is provided by the airfield staff, is approximately 4 hours and requires passage of a test administered by the airfield staff. Drivers and guards shall be able to communicate clearly with ATC and be able to observe and understand light gun signals from the ATC Tower.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 20 00.00 25

PRICE AND PAYMENT PROCEDURES
12/14
NAVFAC SE VERSION

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. ARMY CORPS OF ENGINEERS (USACE)

EP-1110-1-8	(2009) Construction Equipment Ownership and Operating Expense Schedule

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Earned Value Report

1.3 EARNED VALUE REPORT

1.3.1 Data Required

This contract requires the use of a cost-loaded Network Analysis Schedule (NAS). The information required for the Schedule of Prices will be entered as an integral part of the Network Analysis Schedule. Within 7 calendar days of notice of award, prepare and deliver to the Contracting Officer an Earned Value Report (construction contract) as directed by the Contracting Officer. Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices. Costs shall be summarized and totals provided for each construction category.

1.3.2 Schedule Instructions

Payments will not be made until the Earned Value Report from the cost-loaded NAS has been submitted to and accepted by the Contracting Officer. Identify the cost for site work, and include incidental work to the 5 ft line. Identify costs for the building(s), and include work out to the 5 ft line. Work out to the 5 ft line shall include construction encompassed within a theoretical line 5 ft from the face of exterior walls and shall include attendant construction, such as pad mounted HVAC cooling equipment, cooling towers, and transformers placed beyond the 5 ft line.

1.3.3 Real Property Assets

The Government will provide the Draft DD Form 1354, Transfer and Acceptance

of Military Real Property filled in with the appropriate Real Property Unique Identifiers (RPUID) and related construction Category Codes to summarize the designed real property assets that apply to this contract. The Contractor shall meet with the Contracting Officer and the Real Property Accounting Officer during the Pre Construction Meeting and the Project Closeout Meetings to modify and include any necessary changes to the DD Form 1354. The Contractor shall provide the Interim DD Form 1354 that uses the appropriate division of the RPUIDs/ Category Codes to represent the final constructed facility and include all associated cost. Coordinate the Contractor's Price and Payment structure with the structure of the RPUIDs/ Category Codes.

Divide detailed asset breakdown into the RPUIDs and related construction Category Codes and populate associated costs which represent all aspects of the work. Where assets diverge into multiple RPUID/ Category Codes, divide the asset and provide the proportion of the assets in each RPUID/ Category Code. Assets and related RPUID/ Category Codes may be modified by the Contracting Officer as necessary during course of the work. Coordinate identification and proportion of these assets with the Government Real Property Accounting Officer.

Cost data accumulated under this section are required in the preparation of DD Form 1354.

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 EP-1110-1-8.

1.5 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.5.1 Content of Invoice

Requests for payment will be processed in accordance with the Contract Clause FAR 52.232-27, Prompt Payment Construction Contracts and FAR 52.232-5, Payments Under Fixed-Price Construction Contracts. The requests for payment shall include the documents listed below.

a. Updated Project Schedule and reports required by the contract.

b. Contractor Safety Self Evaluation Checklist.

c. Other supporting documents as requested.

d. Updated copy of submittal register.

e. Invoices not completed in accordance with contract requirements will be returned to the Contractor for correction of the deficiencies.

f. Contractor's Monthly Estimate for Voucher (NAVFAC LANT Form 4-330/110 (New 7/84)) with Subcontractor and supplier payment certification.

g. Affidavit to accompany invoice (NAVFAC LANT NORVA Form 4-4235/4 (Rev.5/81)).

h. Materials on Site.

1.5.2 Submission of Invoices

If NFAS Clause 5252.232-9301 is included in the contract, the documents listed in paragraph "CONTENT OF INVOICE" shall be provided in their entirety as attachments in Wide Area Work Flow (WAWF) for each invoice submitted. The maximum size of each WAWF attachment is two megabytes, but there are no limits on the number of attachments. If a document cannot be attached in WAWF due to system or size restriction it shall be provided as instructed by the Contracting Officer.

Monthly invoices and supporting forms for work performed through the anniversary award date of the contract shall be submitted to the Contracting Officer within 5 calendar days of the date of invoice. For example, contract award date is the 7th of the month, the date of each monthly invoice shall be the 7th and the invoice shall be submitted by the 12th of the month.

1.5.3 Final Invoice

a. A final invoice shall be accompanied by the certification required by DFARS 252.247.7023 TRANSPORTATION OF SUPPLIES BY SEA, and the Contractor's Final Release. If the Contractor is incorporated, the Final Release shall contain the corporate seal. An officer of the corporation shall sign and the corporate secretary shall certify the Final Release.

b. For final invoices being submitted via WAWF, the original Contractor's Final Release Form and required certification of Transportation of Supplies by Sea must be provided directly to the respective Contracting Officer prior to submission of the final invoice. Once receipt of the original Final Release Form and required certification of Transportation of Supplies by Sea has been confirmed by the Contracting Officer, the Contractor shall then submit final invoice and attach a copy of the Final Release Form and required certification of Transportation of Supplies by Sea in WAWF.

c. Final invoices not accompanied by the Contractor's Final Release and required certification of Transportation of Supplies by Sea will be considered incomplete and will be returned to the Contractor.

1.6 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor which comply with the requirements of this section, and will be subject to reduction for overpayments or increase for underpayments made on previous payments to 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 reductions and/or suspensions permitted under the FAR and agency regulations including the following in accordance with "FAR 32.503-6:

a. Reasonable deductions due to defects in material or workmanship;

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

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

d. Failure to provide up to date record drawings not current as stated in Contract Clause "FAC 5252.236-9310, Record Drawings."

1.6.2 Payment for Onsite and Offsite Materials

Progress payments may be made to the contractor for materials delivered on the site, for materials stored off construction sites, or materials that are in transit to the construction sites under the following conditions:

a. FAR 52.232-5(b) Payments Under Fixed Price Construction Contracts.

b. Materials delivered on the site but not installed, including completed preparatory work, and off-site materials to be considered for progress payment shall be major high cost, long lead, special order, or specialty items, not susceptible to deterioration or physical damage in storage or in transit to the construction site. Examples of materials acceptable for payment consideration include, but are not limited to, structural steel, non-magnetic steel, non-magnetic aggregate, equipment, machinery, large pipe and fittings,precast/prestressed concrete products, plastic lumber (e.g., fender piles/curbs), and high-voltage electrical cable. Materials not acceptable for payment include consumable materials such as nails, fasteners, conduits, gypsum board, glass, insulation, and wall coverings.

c. Materials to be considered for progress payment prior to installation shall be specifically and separately identified in the Contractor's estimates of work submitted for the Contracting Officer's approval in accordance with Earned Value Report requirement of this contract. Requests for progress payment consideration for such items shall be supported by documents establishing their value and that the title requirements of the clause at FAR 52.232-5 have been met.

d. Materials are adequately insured and protected from theft and exposure.

e. Provide a written consent from the surety company with each payment request for offsite materials.

f. Materials to be considered for progress payments prior to installation shall be stored on site. Other locations are subject to written approval by the Contracting Officer.

g. Materials in transit to the job site or storage site are not acceptable for payment.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 30 00.00 25

ADMINISTRATIVE REQUIREMENTS
12/14
NAVFAC SE VERSION

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

View location map; G

Progress and completion pictures; G

1.2 VIEW LOCATION MAP

Submit to the Contracting Officer, prior to or with the first digital photograph submittals, a sketch or drawing indicating the required photographic locations. Update as required if the locations are moved.

1.3 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color 2mb minimum resolution in JPEG file format showing the sequence and progress of work. Take a minimum of 10 digital photographs each week throughout the entire project from a minimum of five views from points located by the Contracting Officer. Submit a view location sketch indicating points of view. Submit with the monthly invoice two sets of digital photographs each set on a separate CD-R, cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Photographs for each month shall be in a separate monthly directory and each file shall be named to indicate its location on the view location sketch. The view location sketch shall also be provided on the CD as digital file. All file names shall include a date designator. Cross reference submittals in the appropriate daily report. Photographs shall be provided for unrestricted use by the Government.

1.4 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 for bodily injury, $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.

f. Prior to commencement of work hereunder, the Contractor shall furnish to the Contracting Officer a certificate or written statement of the above required insurance. The policies evidencing required insurance shall contain an endorsement to the effect that cancellation or any material change in the policies adversely affecting the interests of the Government in such insurance shall not be effective until 30 days after written notice thereof to the Contracting Officer.

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 (QC) representative is required on the contract, then that individual shall also have fluent English communication skills.

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 or earned value report, shop drawings, and other submittals, scheduling programming, prosecution of the work, and clear expectations of the "Interim DD Form 1354" Submittal. Major subcontractors who will engage in the work shall also attend.

1.7 FACILITY TURNOVER PLANNING MEETINGS (NAVFAC Red Zone - NRZ)

Key personnel will meet to identify strategies to ensure the project is carried to expeditious closure and turnover to the Client. Start the turnover process at the Pre Construction Conference meeting and convene at the Facility Turnover Meetings once the project has reached approximately 75 percent completion or three to six months prior to Beneficial Occupancy Date (BOD), whichever comes first. The Contracting Officer's Representative will lead the meetings and guide discussions based on an agenda provided by the Government. The facility Turnover effort shall include the following:

a. Pre Construction Meeting - Contracting Officer's Technical Representative (COTR) will provide the NRZ Checklist and the Contractor, Client, and NAVFAC Representatives will compare Contractor's schedule to NRZ Checklist items.

b. Facility Turnover Meetings

1. Fill in the NRZ Checklist including Contractor, Client, and NAVFAC Checklist Items and assign a person responsible for each item and a due date. The Contractor's Representative will facilitate the assignment of responsibilities, fill out the NRZ Checklist, and discuss "Interim DD Form 1354" requirements.

2. Review the Contractor's updated schedule. The Contractor shall

develop a POAM for the completion of all Contractor, Client, and NAVFAC Checklist items.

3. Confirm that all NRZ Checklist items will be completed on time for the scheduled Facility Turnover.

1.8 PARTNERING

To most effectively accomplish this contract, the Government requires the formation of a cohesive partnership within the Project Team whose members are from the Government, the Contractor and their Subcontractors. Key personnel from the Supported Command, the End User (who will occupy the facility), NAVFAC (Echelon III and IV), the Navy Region/Installation, the Contractor and Subcontractors, and the Designer of Record will be invited to participate in the Partnering process. The Partnership will draw on the strength of each organization in an effort to achieve a project that is without any safety mishaps, conforms to the Contract, and stays within budget and on schedule.

The Contracting Officer will provide Information on the Partnering Process and a list of key and optional personnel who should attend the Partnering meeting.

1.8.1 Informal Partnering

The Contracting Officer will organize the Partnering Sessions with key personnel of the project team, including Contractor personnel and Government personnel.

The Initial Partnering session should be a part of the Pre-Construction Meeting. Partnering sessions will be held at a location agreed to by the Contracting Officer and the Contractor (typically a conference room provided by the PWD FEAD/ROICC office or the Contractor).

The Initial Informal Partnering Session will be conducted and facilitated using electronic media (a video and accompanying forms) provided by the Contracting Officer.

The Partners will determine the frequency of the follow-on sessions.

1.9 AVAILABILITY OF CADD DRAWING FILES

After award and upon request, the electronic "Computer-Aided Drafting and Design (CADD)" drawing files will only be made available to the Contractor for use in preparation of construction data related to the referenced contract subject to the following terms and conditions. Request specific drawing numbers of files required; the entire set of drawing files will not be provided.

Data contained on these electronic files shall not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor shall make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor shall, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable

attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CADD drawing files are not construction documents. Differences may exist between the CADD files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic CADD files, nor does it make representation to the compatibility of these files with the Contractors hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished CADD files, the signed and sealed construction documents shall govern. The Contractor is responsible for determining if any conflict exists. Use of these CADD files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project.

If the Contractor uses, duplicates and/or modifies these electronic CADD files for use in producing construction data related to this contract, all previous indicia of ownership (seals, logos, signatures, initials and dates) shall be removed.

1.10 ELECTRONIC MAIL (E-MAIL) ADDRESS

The Contractor shall establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments in Microsoft, Adobe Acrobat, and other similar formats. Within 10 days after contract award, the Contractor shall provide the Contracting Officer a single (only one) e-mail address for electronic communications from the Contracting Officer related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The Contracting Officer may also use email to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes, terrorist threats, etc. Multiple email address will not be allowed.

It is the Contractor's responsibility to make timely distribution of all Contracting Officer initiated e-mail with its own organization including field office(s). The Contractor shall promptly notify the Contracting Officer, in writing, of any changes to this email address.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 32 17.00 25

COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS)
03/15
NAVFAC SE VERSION

PART 1 GENERAL

1.1 DESCRIPTION

The Contractor is responsible for scheduling procurement, Contractor quality control and construction, acceptance testing and training. Refer to Specification Section 01 33 00 SUBMITTAL PROCEDURES to determine if any items require Government approval prior to construction; if any are required, include that submittal review time in the schedule.

The schedule is a tool to manage the project, both for Contractor and Government activities. It will also be used to report progress and evaluate time extensions. The Project NAS must be cost-loaded and will provide the basis for progress payments. Use the Critical Path Method (CPM) and the Precedence Diagram Method (PDM) to satisfy time and cost applications. For consistency, when scheduling software terminology is used in this specification, the terms in Primavera's scheduling programs are used.

1.2 SUBMITTALS

The use of a "G" following a submittal indicates that a Government approval action is required. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Qualifications; G

Baseline Network Analysis Schedule (NAS); G

SD-07 Certificates

Monthly Network Analysis Schedule Update; G

SD-11 Closeout Submittals

As-Built Schedule; G

1.3 SCHEDULE ACCEPTANCE PRIOR TO START OF WORK

The Contracting Officer and Contractor will participate in a preliminary meeting(s) to discuss the proposed schedule and requirements of this section prior to the Contractor preparing the Project Baseline Schedule. Government review comments on the Contractor's schedule(s) do not relieve the Contractor from compliance with requirements of the Contract Documents. Only bonds may be paid prior to acceptance of the Baseline Network Analysis Schedule (NAS) The acceptance of a Baseline NAS is a condition precedent to:

a. The Contractor starting work on the demolition or construction stage(s) of the contract.

b. Processing Contractor's invoices(s) for construction activities/items of work.

c. Review of any schedule updates.

Submittal of the Baseline Network Analysis Schedule, and subsequent schedule updates, is understood to be the Contractor's certification that the submitted schedule meets all of the requirements of the Contract Documents, represents the Contractor's plan on how the work will be accomplished, and accurately reflects the work that has been accomplished and how it was sequenced (as-built logic).

1.4 SOFTWARE

Prepare and maintain project schedules using Primavera P6. Importing data into P6 using data conversion techniques or third party software is cause for rejection of the submitted schedule.

A listing of Primavera P6 settings and parameters which must be used in preparing the Schedules are contained later in this specification section. Deviation from these settings and parameters, without prior consent of the Contracting Officer, is cause for rejection of schedule submission.

1.5 QUALIFICATIONS

The designated Scheduler for the project must have prepared and maintained at least 3 previous schedules of similar size and complexity of this contract using Primavera P3, Primavera SureTrak, or Primavera P6. At least one of the three must be in Primavera P6. Submit a resume outlining the qualifications of the Scheduler. Payment will not be processed until an acceptable Scheduler is provided.

1.6 NETWORK SYSTEM FORMAT

The system must include time-scaled logic diagrams and specified reports.

1.6.1 Diagrams

Provide Time-scaled Logic Diagram printed in color on ANSI D size sheets. The diagram must clearly show activities on the critical path. Include the following information for each activity:

a. Activity ID

b. Activity Description

c. Original Duration in Work Days

d. Remaining duration in Work Days

e. Physical Percent Complete

f. Start Date

g. Finish Date

h. Total Float

1.6.2 Schedule Activity Properties and Level of Detail

The NAS must identify all Government, Construction Quality Management (CQM), Construction activities planned for the project and all other activities that could impact project completion if delayed. Create separate activities for each Phase, Area, Floor Level and Location the activity is occurring. Activity categories included in the schedule are specified below.

With the exception of the Contract Award and Contract Completion Date (CCD) milestone activities, no activity may be open-ended; each activity must have predecessor and successor ties. No activity may have open start or open finish (dangling) logic. Minimize redundant logic ties. Once an activity exists on the schedule it must not be deleted or renamed to change the scope of the activity and must not be removed from the schedule logic without approval from the Contracting Officer. While an activity cannot be deleted, where said activity is no longer applicable to the schedule but remains within the logic stream for historical record, it can be changed to a milestone. Document any such change in the milestone's "Notebook", including a date and explanation for the change. The ID number for a deleted activity must not be re-used for another activity. Within the Baseline Schedule no more than 20 percent of the activities may be critical or near critical. Critical is defined as having zero days of Total Float. "Near Critical" is defined as having Total Float of 1 to 14 days. Contractor activities must be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days.

1.6.2.1 Activity Categories

1.6.2.1.1 Procurement Activities

Examples of procurement activities include, but are not limited to; Material/equipment submittal preparation, submittal and approval of material/equipment; material/equipment fabrication and delivery, and material/equipment on-site. As a minimum, separate procurement activities will be provided for critical items, long lead items, items requiring Government approval and material/equipment procurement for which payment will be requested in advance of installation. Show each delivery with relationship tie to the Construction Activity specifically for the delivery.

1.6.2.1.2 Government Activities

Government and other agency activities that could impact progress must be clearly identified. Government activities include, but are not limited to; Government approved submittal reviews, Government conducted inspections/tests, environmental permit approvals by State regulators, utility outages, and delivery of Government Furnished Material/Equipment.

1.6.2.1.3 Quality Management (QM) Activities

The Preparatory Phase and Initial Phase for each Definable Feature of Work identified in the Contractor's Quality Control Plan must be added to each Three-Week Look Ahead Schedule referenced in the paragraph THREE-WEEK LOOK AHEAD SCHEDULE. The Follow-up Phase will be represented by the Construction Activities in the Baseline Schedule and in the schedule updates.

1.6.2.1.4 Construction Activities

No on-site construction activity may have a duration in excess of 20 working days. Contractor activities must be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days, unless otherwise defined in this contract.

1.6.2.1.5 Turnover and Closeout Activities

Include activities with all items on the NAVFAC Red Zone Checklist/POAM that are applicable to this project. As a minimum, include all testing, specialized inspection activities, Pre-Final Inspection, Punch List Completion, Final Inspection and Acceptance. Add a milestone for the Facility Turnover Planning Meeting at approximately 75 percent construction contract completion or three to six months prior to Contract Completion Date (CCD), whichever is sooner.

1.6.2.2 Contract Milestones and Constraints

1.6.2.2.1 Project Start Date Milestones

Include as the first activity on the schedule a start milestone titled "Contract Award", which must have a Mandatory Start constraint equal to the Contract Award Date.

1.6.2.2.2 Facility Turnover Planning Meeting Milestones

See paragraph ACTIVITY CATEGORIES above.

1.6.2.2.3 Substantial Completion Milestone

Include an unconstrained finish milestone on the schedule titled "Substantial Completion". Substantial Completion is defined as the point in time the Government would consider the project ready for beneficial occupancy wherein by mutual agreement of the Government and Contractor, Government use of the facility is allowed while construction access continues in order to complete remaining items (e.g. punch list and other close out submittals).

1.6.2.2.4 Projected Completion Milestone

Include an unconstrained finish milestone on the schedule titled "Projected Completion". Projected Completion is defined as the point in time the Government would consider the project complete. This milestone must have the Contract Completion (CCD) milestone as its only successor.

1.6.2.2.5 Contract Completion Date (CCD) Milestone

Include as the last activity on the schedule a finish milestone titled "Contract Completion (CCD)". Calculation of schedule updates will be such that if the finish of the "Projected Completion" milestone falls after the contract completion date, then negative float will be calculated on the longest path and if the finish of the "Projected Completion" milestone falls before the contract completion date, the float calculation must reflect positive float on the longest path.

1.6.2.3 Work Breakdown Structure & Activity Code

At a minimum, the Contractor must establish a Work Breakdown Structure

(WBS) and provide activity codes identified as follows:.

1.6.2.3.1 Work Breakdown Structure (WBS)

Group all activities and milestones within appropriate WBS categories including, at a minimum, the following:

a. Project Milestones:

(1) Management Milestones

(2) Project Administrative Meetings

b. Pre-Construction Phase:

(1) Submittals and Reviews

(2) Procurement

c. Construction Phase; Create multiple sub-sections in accordance with project specific categories of work including in WBS descending order as follows:

(1) General Area

(a) Type of Work Item

1. Location

d. Commissioning & Testing:

(1) Specific area/locations of commissioning

(2) Final Testing

(3) Training

e. Project Closeout: Include activity items such as Punchlist, Demobilization, O&M, As-built Drawings, and As-built NAS.

f. Modifications: Create multiple sub-sections as the project progresses identified by modifications issued.

1.6.2.3.2 Responsibility Code

All activities in the project schedule must be identified with the party responsible for completing the task. Activities must not belong to more than one responsible party.

1.6.2.3.3 Construction Specification Institute (CSI) Masterformat Code

Identify all activities in the project schedule with its respective Specification Section number. Activities must not belong to more than one Section number. If an activity does not have an applicable CSI Code (e.g. Mobilize), the code must be "0000".

1.6.2.3.4 Drawing Code

Identify all activities in the project schedule with its respective Drawing

Code. The Drawing Code is the Sheet Number on the primary project drawing which indicates work to be performed. If an activity does not have an applicable Drawing Code (e.g. Mobilize), the code must be "0000".

1.6.2.4 Anticipated Weather Lost Work Days

Use the following schedule of anticipated monthly non-work days due to adverse weather as the basis for establishing a "Weather Calendar" showing the number of anticipated non-workdays for each month due to adverse weather, in addition to Saturdays, Sundays and all Federal Holidays as non-work days.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAYS											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2	2	1	1	1	1	1	2	2	1	1	3

* Based on NOAA records 1981-2010 including days > 100 degrees F; days < 32 degrees F; days with precipitation > 1.0 inches; and days with snow > 1.0 inches in Corpus Christi, TX.

Assign the Weather Calendar to any activity that could be impacted by adverse weather. The Contracting Officer will issue a modification in accordance with the contract clauses, giving the Contractor a time extension for the difference of days between the anticipated and actual adverse weather delay if the number of actual adverse weather delay days exceeds the number of days anticipated for the month in which the delay occurs and the adverse weather delayed activities are critical to contract completion. A lost workday due to weather conditions is defined as a day in which the Contractor cannot work at least 50 percent of the day on the impacted activity.

1.6.2.5 Anticipated Restricted Delays

Unless otherwise noted or defined in Section 01 14 00.00 25 WORK RESTRICTIONS, allow in the schedule a total of 5 lost workdays per calendar year for instances where base access is not permitted due to a restriction or closure which causes a delay in the work. A lost workday is defined as a day which the Contractor cannot work at least 50 percent of the day on the closed installation. If the installation is closed for a period longer than 5 lost workdays per calendar year, the Contracting Officer will issue a no cost contract modification as applicable in accordance with the contract clauses extending the contract completion date where the critical path has been impacted.

1.6.2.6 Cost Loading

1.6.2.6.1 Quantities and Units of Measure

Each cost loaded activity must have a detailed quantity breakdown and unit of measure. Lump sum costing is not acceptable.

1.6.3 Schedule Software Settings and Restrictions

a. Activity Constraints: Date/time constraint(s), other than those required by the contract, are not allowed unless accepted by the Contracting Officer. Identify any constraints proposed and provide an

explanation for the purpose of the constraint in the Narrative Report as described in Paragraph REQUIRED TABULAR REPORTS.

b. Default Progress Data Disallowed: Actual Start and Actual Finish dates on the CPM schedule must match the dates on the Contractor Quality Control and Production Reports.

c. Software Settings: Handle schedule calculations and Out-of-Sequence progress (if applicable) through Retained Logic, not Progress Override. Show all activity durations and float values in days. Show activity progress using Remaining Duration. Set default activity type to "Task Dependent".

d. At a minimum, include the following settings and parameters in Baseline Schedule preparation:

(1) General: Define or establish Calendars and Activity Codes at the "Project" level, not the "Global" level.

(2) Admin Drop-Down Menu, Admin Preferences, Time Periods Tab:

(a) Set time periods for P6 to 8.0 Hours/Day, 40.0 Hours/Week, 172.0 Hours/Month and 2000.0 Hours/Year.

(b) Use assigned calendar to specify the number of work hours for each time period: Must be checked.

(3) Admin Drop-Down Menu, Admin Preferences, Earned Value Tab:

(a) Earned Value Calculation: Use "Budgeted values with current dates".

(4) Project Level, Dates Tab:

(a) Set "Must Finish By" date to "Contract Completion Date".

(5) Project Level, Defaults Tab:

(a) Duration Type: Set to "Fixed Duration & Units".

(b) Percent Complete Type: Set to "Physical".

(c) Activity Type: Set to "Task Dependent".

(d) Calendar: Set to "Standard 5 Day Workweek". Calendar must reflect Saturday, Sunday and all Federal holidays as non-work days. Alternative calendars may be used with Contracting Officer approval.

(6) Project Level, Calculations Tab:

(a) Activity percent complete based on activity steps: Must be Checked.

(b) Reset Remaining Duration and Units to Original: Must be Checked.

(c) Subtract Actual from At Completion: Must be Checked.

(d) Recalculate Actual units and Cost when duration % complete changes: Must be Checked.

(e) Link Actual to Date and Actual This Period Units and Cost: Must be Checked.

(f) Price/Unit: Set to "$1/h".

(g) Update units when costs change on resource assignments: Must be Unchecked.

(7) Project Level, Settings Tab:

(a) Define Critical Activities: Check "Total Float is less than or equal to" and add "0d".

(8) Work Breakdown Structure Level, Earned Value Tab:

(a) Technique for Computing Performance Percent Complete: "Activity percent complete" is selected.

(b) Technique for Computing Estimate to Complete (ETC): "PF = 1" is selected.

1.6.4 Required Tabular Reports

Include the following reports with the Baseline, Monthly Update and any other required schedule submittals:

a. Log Report: Listing of all changes made between the previous schedule and current updated schedule.

b. Narrative Report: Identify and justify:

(1) Progress made in each area of the project;

(2) Critical Path;

(3) Date/time constraint(s), other than those required by the contract

(4) Changes in the following; added or deleted activities, original and remaining durations for activities that have not started, logic, milestones, planned sequence of operations, critical path, and cost loading;

(5) Any decrease in previously reported activity Earned Amount;

(6) Pending items and status thereof, including permits, changes orders, and time extensions;

(7) Status of Contract Completion Date and interim milestones;

(8) Current and anticipated delays (describe cause of delay and corrective actions(s) and mitigation measures to minimize);

(9) Description of current and future schedule problem areas.

Each entry in the narrative report must cite the respective Activity ID and Activity Description, the date and reason for the change, and

description of the change.

c. Earned Value Report: List all activities having a budget amount cost loaded. Compile total earnings on the project from notice to proceed to current progress payment request. Show current budget, previous physical percent complete, to-date physical percent complete, previous earned value, to-date earned value and cost to complete on the report for each activity.

d. Schedule Variance Control (SVC) Diagram: With each schedule submission, provide a SVC diagram showing 1) Cash Flow S-Curves indicating planned project cost based on projected early and late activity finish dates and 2) Earned Value to-date. Revise Cash Flow S-Curves when the contract is modified, or as directed by the Contracting Officer.

e. Daily Reported Production Activity: Submit on a monthly basis, in electronic spreadsheet format, a summary of daily reported production activity for the reporting month in the update schedule. Use the following columns for reporting:

(1) Date

(2) Activity ID

(3) Work Description

(4) Contractor

(5) Billable Hours

1.7 SUBMISSION AND ACCEPTANCE

1.7.1 Monthly Network Analysis Updates

Contractor and Government representatives will meet at monthly intervals to review and agree on the information presented in the updated project schedule. The submission of an acceptable, updated schedule to the Government is a condition precedent to the processing of the Contractor's invoice. Submit an acceptable, updated schedule to the Government regardless of whether a Contractor's invoice is submitted for the given period. The Contractor and Government consent to agree on percentage of payment for each activity progressed during the update period. Monthly update schedules must incorporate as-built events as they occurred and provide ongoing status of anticipated finish dates. As-built events must correspond to contemporaneous records including but not limited to submittals, daily production reports and quality control reports.

Provide the following with each Schedule submittal:

a. Time-Scaled Logic Diagram.

b. Reports listed in paragraph entitled "REQUIRED TABULAR REPORTS."

c. Data disks containing the project schedule. Include the back-up native .xer program files.

1.7.2 As-Built Schedule

As a condition precedent to the release of retention and making final payment, submit an "As-Built Schedule," as the last schedule update showing all activities at 100 percent completion. This schedule must reflect the exact manner in which the project was actually constructed.

1.8 CONTRACT MODIFICATION

Submit a Time Impact Analysis (TIA) with each cost and time proposal for a proposed change. TIA must illustrate the influence of each change or delay on the Contract Completion Date or milestones. No time extensions will be granted nor delay damages paid unless a delay occurs which consumes all available Project Float, and extends the Projected Finish beyond the Contract Completion Date.

a. Each TIA must be in both narrative and schedule form. The narrative must define the scope and conditions of the change; provide start and finish dates of impact, successor and predecessor activity to impact period, responsible party; describe how it originated, and how it impacts the schedule. The schedule submission must consist of three native files:

(1) Fragnet used to define the scope of the changed condition

(2) Most recent accepted schedule update as of the time of the proposal or claim submission that has been updated to show all activity progress as of the time of the impact start date.

(3) The impacted schedule that has the fragnet inserted in the updated schedule and the schedule “run” so that the new completion date is determined.

b. For claimed as-built project delay the inserted fragnet TIA method must be modified to account for as-built events known to occur after the data date of schedule update used.

c. All TIAs must include any mitigation, and must determine the apportionment of the overall delay assignable to each individual delay. The associated narrative must clearly describe the findings in a chronological listing beginning with the earliest delay event.

(1) Identify types of delays as follows:

(a) Excusable Delay: Force-Majeure (e.g. weather) - Contractor may receive time extension, but time will not be compensable.

(b) Inexcusable Delay: Contractor Responsibility – Contractor will not receive time extension.

(c) Compensable Delay: Government Responsibility – Contractor may receive compensable time extension.

(2) If a combination of delay types occurs, it is considered Concurrent Delay, which is defined in the following combinations:

(a) Excusable Delay and Compensable Delay results in Excusable Delay

(b) Excusable Delay and Inexcusable Delay results in Inexcusable Delay

(c) Compensable Delay and Inexcusable Delay results in Excusable Delay

d. Submit Data disks containing the narrative and native schedule files.

e. Unless the Contracting Officer requests otherwise, only add conformed contract modifications into the Project NAS.

1.8.1 No Reservation of Rights

All direct costs, indirect cost, and time extensions will be negotiated and made full, equitable and final at the time of modification issuance.

1.9 PROJECT FLOAT

Project Float is the length of time between the Contractor's Projected Completion Milestone and the Contract Completion Date Milestone. Project Float available in the schedule will not be for the exclusive use of either the Government or the Contractor.

The use of Resource Leveling or other techniques used for the purpose of artificially adjusting activity durations to consume float and influence critical path is prohibited.

1.10 THREE-WEEK LOOK AHEAD SCHEDULE

Prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Project Network Analysis Schedule. Key the work plans to NAS activity numbers and update each week to show the planned work for the current and following two-week period. Additionally, include upcoming outages, closures, field evaluation tests, preparatory meetings, and initial meetings. Identify critical path activities on the Three-Week Look Ahead Schedule. The detail work plans are to be bar chart type schedules, derived from but maintained separately from the Project NAS on an electronic spreadsheet program and printed on 8-1/2 by 11 inch sheets as directed by the Contracting Officer. Activities must not exceed 5 working days in duration and have sufficient level of detail to assign crews, tools and equipment required to complete the work. Deliver three hard copies and one electronic file of the 3-Week Look Ahead Schedule to the Contracting Officer no later than 8 a.m. each Monday and reviewed during the weekly CQC Coordination and/or Production Meeting.

1.11 CORRESPONDENCE AND TEST REPORTS

All correspondence (e.g., letters, Requests for Information (RFIs), e-mails, meeting minute items, Production and QC Daily Reports, material delivery tickets, photographs) must reference Schedule activity IDs that are being addressed. All test reports (e.g., concrete, soil compaction, weld, pressure) must reference schedule activity IDs that are being addressed.

1.12 ADDITIONAL SCHEDULING REQUIREMENTS

Any references to additional scheduling requirements, including systems to be inspected, tested and commissioned, that are located throughout the remainder of the Contract Documents, are subject to all requirements of

this section.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES
03/15
NAVFAC SE VERSION

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to commencing work on site:

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction progress schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices or Earned Value Report

Health and safety plan

Work plan

Quality Control(QC) 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, systems or equipment for some portion of the work.

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

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

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. Unless specified in another section, 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 logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and 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 manufacturer, supplier, installer or Subcontractor through Contractor. The document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS)concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

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

Submittals required for Guiding Principle Validation (GPV) or Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

Interim "DD Form 1354" with cost breakout for all assets 30 days prior to facility turnover.

1.1.2 Approving Authority

Office or designated person authorized to approve submittal.

1.1.3 Work

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

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor QC approval. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register; G

1.3 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.3.1 Submittals Required from the Contractor

One day after award of contract, and before procurement of fabrication, forward to the submittals required in the technical sections of this specification, including shop drawings, product data and samples. Forward one copy of the transmittal form electronically in PDF format for all submittals to the Contracting Officer.

The NAVFAC Construction Manager will review and approve for the Contracting Officer those submittals reserved for Contracting Officer approval to verify submittals comply with the contract requirements.

1.3.1.1 O&M Data

The NAVFAC Construction Manager will review and approve for the Contracting Officer O&M Data to verify the submittals comply with the contract requirements; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

In the event the Contractor fails to deliver O&M Data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data are applicable.

1.4 PREPARATION

1.4.1 Transmittal Form

Transmit each submittal electroncially in PDF Format, except sample installations and sample panels to office of approving authority. Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled, "Identifying Submittals," of this section. Process transmittal forms to record actions

regarding samples .

1.4.2 Identifying Submittals

When submittals are provided by a Subcontractor, the Prime Contractor is to prepare, review and stamp with Contractor's approval all specified submittals prior to submitting for Government approval.

Identify submittals, except sample installations and sample panels, 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. Date of the drawings and revisions.

d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.

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

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

g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

h. Product identification and location in project.

1.4.3 Format for SD-02 Shop Drawings

Shop drawings are not to be less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

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.

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

Number drawings in a logical sequence. Each drawing is to bear the number of the submittal in a uniform location adjacent to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

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

Include the nameplate data, size and capacity on drawings. Also include applicable federal, military, industry and technical society publication

references.

Submit drawings electronically in PDF format.

1.4.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

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.

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

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, with information and format as required for submission of SD-07 Certificates.

Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

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), ASTM International (ASTM), National Electrical Manufacturer's 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. 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. State on the certificate 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.

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of construction effort.

Submit manufacturer's instructions prior to installation.

1.4.5 Format of SD-04 Samples

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

a. Sample of Equipment or Device: Full size.

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

c. 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.

d. 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.

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

f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

g. Sample Panel: 4 by 4 feet.

h. Sample Installation: 100 square feet.

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

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

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

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

1.4.6 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

1.4.7 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Provide reports on 8 1/2 by 11 inches paper in a complete bound volume.

Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.4.8 Format of SD-10 Operation and Maintenance Data (O&M)

1.4.9 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

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.

1.5 QUANTITY OF SUBMITTALS

1.5.1 Number of Copies of SD-02 Shop Drawings

Submit shop drawings requiring review and approval by Contracting Officer electronicially in PDF Format. Submit one full size paper copy. The paper copy will not be returned to the Contractor.

1.5.2 Number of Copies of SD-03 Product Data and SD-08 Manufacturer's Instructions

Submit in compliance with quantity requirements specified for shop drawings.

1.5.3 Number of Samples SD-04 Samples

a. Submit one sample of each required item.

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

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.5.4 Number of Copies SD-05 Design Data and SD-07 Certificates

Submit in compliance with quantity requirements specified for shop drawings.

1.5.5 Number of Copies SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Submit in compliance with quantity and quality requirements specified for shop drawings other than field test results that will be submitted with QC reports.

1.5.6 Number of Copies of SD-10 Operation and Maintenance Data

Submit three copies of O&M Data to the Contracting Officer for review and approval.

1.5.7 Number of Copies of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

Unless otherwise specified, submit two sets of administrative submittals.

1.6 VARIATIONS

Variations from contract requirements require Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.6.1 Considering Variations

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

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

1.6.2 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 savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.6.3 Warranting that Variations 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.

1.6.4 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.

1.7 SUBMITTAL REGISTER

Prepare and maintain submittal register, as the work progresses. 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. A submittal register showing items of equipment and materials for which submittals are required by the specifications is provided as an attachment. This list may not be all inclusive and additional submittals may be required. The Government will provide the initial submittal register with 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-02 Shop 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.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Government.

1.7.1 Use of Submittal Register

Submit submittal register with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register submitted with the QC plan and the project schedule:

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.

1.7.2 Contractor Use of Submittal Register

Update the following fields with each submittal throughout contract.

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.

1.7.3 Approving Authority Use of Submittal Register

Update the following fields.

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

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.7.4 Action Codes

Entries for columns (j) and (o), are to be used are as follows (others may be prescribed by Transmittal Form):

1.7.4.1 Government Review Action Codes

"A" - "Approved as submitted"; "Completed"

"B" - "Approved, except as noted on drawings"; "Completed"

"C" - "Approved, except as noted on drawings; resubmission required"; "Resubmit"

"D" - "Returned by separate correspondence"; "Completed"

"E" - "Disapproved (See attached)"; "Resubmit"

"F" - "Receipt acknowledged"; "Completed"

"G" - "Other (Specify)"; "Resubmit"

"X" - "Receipt acknowledged, does not comply with contract requirements"; "Resubmit"

1.7.5 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request..

1.8 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

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 resubmittal of requirements.

b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."

c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.

d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

e. 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.

g. Period of review for each resubmittal is the same as for initial submittal.

1.8.1 Reviewing, Certifying, Approving Authority

The QC organization is responsible for reviewing and certifying that submittals are in compliance with contract requirements. Approving

authority on submittals is QC Manager unless otherwise specified for specific submittal. At each "Submittal" paragraph in individual specification sections, a notation "G," following a submittal item, indicates Contracting Officer is approving authority for that submittal item.

1.8.2 Constraints

Conform to provisions of this section, unless explicitly stated otherwise for submittals listed or specified in this contract.

Submit complete submittals for each definable feature of work. Submit at the same time components of definable feature interrelated as a system.

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

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

1.8.3 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, "Approved/Accepted Submittals," of the section."

(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 _____, 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)

(2) When approving authority is QC Manager, QC Manager will use the following approval statement when returning submittals to Contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with contract Number _____, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is approved for use.

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

Approved by QC Manager _____, Date _____"
(Signature)

g. Sign certifying statement or approval statement. The QC organization member designated in the approved QC plan is the person signing certifying statements. The use of original ink for signatures is required. 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.

1.9 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

a. Note date on which submittal was received from QC Manager.

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, "Review Notations," of this section and with markings appropriate for action indicated.

d. Review comments will be provided in electronic format only.

1.9.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.

b. Submittals marked "approved as noted" "or approved, except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

d. 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.

1.10 DISAPPROVED SUBMITTALS

Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes," is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.11 APPROVED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.12 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the

project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 14 00.00 25	SD-01 Preconstruction Submittals															
			List of Contact Personnel	1.3.1.1	G													
		01 20 00.00 25	SD-01 Preconstruction Submittals															
			Earned Value Report	1.3														
		01 30 00.00 25	SD-01 Preconstruction Submittals															
			View location map	1.2	G													
			Progress and completion pictures	1.3	G													
		01 32 17.00 25	SD-01 Preconstruction Submittals															
			Qualifications	1.5	G													
			Baseline Network Analysis	1.3	G													
			Schedule															
			SD-07 Certificates															
			Monthly Network Analysis	1.7.1	G													
			SD-11 Closeout Submittals															
			As-Built Schedule	1.7.2	G													
		01 33 00	SD-01 Preconstruction Submittals															
			Submittal Register	1.7	G													
		01 35 13.00 25	SD-01 Preconstruction Submittals															
			Heavy Equipment and Vehicle	3.1.2														
			List															
			Existing Conditions Survey	3.1.2														
			Construction Operations Plan	3.1.2														
			Safety Plan	3.1.2														
			Schedule of Work	3.1.2														
		01 35 26.00 25	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.7	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 35 26.00 25	Activity Hazard Analysis (AHA)	1.8	G													
			Crane Critical Lift Plan	1.7.1	G													
			Crane Operators		G													
			OSHA Days Away from Work,		G													
			Restricted Duty, or Job Transfer															
			(DART) Rate															
			Experience Modification Rate		G													
			(EMR)															
			SD-06 Test Reports															
			Notifications and Reports	1.12														
			Accident Reports	1.12.2	G													
			Crane Reports	1.12.3														
			SD-07 Certificates															
			Confined Space Entry Permit	1.9														
			Hot work permit	1.9														
			License Certificates															
			Contractor Safety Self-Evaluation	1.4	G													
			Checklist															
			SD-11 Closeout Submittals															
			OSHA Form 300A 'Summary of															
			Work-Related Injuries and															
			Illnesses'															
			OSHA Form 'Calculating Injury															
			and Illness Incidence Rates'															
		01 35 40.00 20	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.8	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 35 40.00 20	Instructor Qualifications	1.9.1														
			SD-06 Test Reports															
			Field Quality Control Reports	3.2														
			SD-07 Certificates															
			Environmental Regulatory	1.6														
			Requirements															
			SD-08 Manufacturer's Instructions															
			Material Safety Data Sheets	1.7.1														
			SD-11 Closeout Submittals															
			Protection of Natural Resources	3.1														
		01 45 00.00 25	SD-01 Preconstruction Submittals															
			Construction Quality Control (QC)	1.6.1	G													
			Plan															
			Basis of Design and Design															
			Intent															
			SD-07 Certificates															
			CA Resume															
		01 50 00.00 25	SD-01 Preconstruction Submittals															
			Construction site plan	1.3	G													
		01 57 16.00 25	SD-01 Preconstruction Submittals															
			Pesticide Treatment Plan	1.5.2	G													
		01 57 19.00 25	SD-01 Preconstruction Submittals															
			Preconstruction Survey	1.5.1	G													
			Solid Waste Management Plan	3.3	G													
			and Permit															
			Regulatory Notifications	1.5.2	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 57 19.00 25	Environmental Protection Plan	1.6	G													
			Storm Water Pollution Prevention	3.1.2.1	G													
			Plan															
			Storm Water Notice of Intent (for	3.1.2.1	G													
			NPDES coverage under the															
			general permit for construction															
			activities)															
			Dirt and Dust Control Plan	3.13.1														
			Contractor Hazardous Material	3.7.1	G													
			Inventory Log															
			SD-06 Test Reports															
			Laboratory Analysis	3.12.2.2														
			Disposal Requirements	3.14.2														
			Erosion and Sediment Control	3.1.2														
			Inspection Reports															
			Storm Water Inspection Reports	3.1.2														
			for General Permit															
			Solid Waste Management Report	3.3.1	G													
			SD-07 Certificates															
			Contractor 40 CFR employee	1.5.5	G													
			training records															
			ECATTS certificate of completion	1.4.1														
			SD-11 Closeout Submittals															
			Storm Water Pollution Prevention	3.1.2.2	G													
			Plan compliance notebook															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 57 19.00 25	Waste Determination	3.4														
			Documentation															
			Disposal Documentation for	3.3.2.1														
			Hazardous and Regulated Waste															
			Contractor 40 CFR Employee	1.5.5														
			Training Records															
			Solid Waste Management Permit	3.3														
			Solid Waste Management Report	3.3.1														
			Contractor Hazardous Material	3.7.1	G													
			Inventory Log															
			Hazardous Waste/Debris	3.12.2														
			Management															
			Regulatory Notifications	1.5.2														
		01 58 00.00 25	SD-02 Shop Drawings															
			Preliminary drawing indicating	1.3.1	G													
			layout and text content															
		01 74 19.00 25	SD-01 Preconstruction Submittals															
			Waste Management Plan	1.5	G													
			SD-11 Closeout Submittals															
			Records	1.6														
		01 75 00.00 25	SD-01 Preconstruction Submittals															
			Quality Control Plan	1.2.1	G													
			Manufacturer's Sample Warranty	1.2.1	G													
			Operation and Maintenance Data	1.2.3	G													
			SD-02 Shop Drawings															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 75 00.00 25	Drawings, Diagrams and	1.2.2	G													
			Schedules															
			Diagrams and Instructions	1.2.2	G													
			SD-03 Product Data															
			Catalog Cuts	1.2.3	G													
			Samples of Warranty Language	1.2.3	G													
			SD-06 Test Reports															
			Factory Tests	1.2.4.1	G													
			Functional Field Test	1.2.4.2	G													
			SD-07 Certificates															
			Qualification of Manufacturer	1.2.1	G													
			Qualification of Applicator or		G													
			Installer															
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Administrative	1.2.1	G													
			Requirements															
			Demonstration and Training	1.2.1	G													
			Information															
			Manufacturer's Procedural	1.2.1	G													
			Requirements															
			SD-09 Manufacturer’s Field															
			Reports															
			Documentation of the Testing	1.2.4.2	G													
			and Verification Actions															
			SD-10 Operation and Maintenance															
			Data															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 75 00.00 25	Operation and Maintenance Data	1.2.3	G													
		01 78 00.00 25	SD-03 Product Data															
			As-Built Record of Equipment	1.3.2														
			and Materials															
			Warranty Management Plan	1.7.1														
			Warranty Tags	1.7.4														
			Spare Parts Data	1.4														
			SD-08 Manufacturer's Instructions															
			Preventative Maintenance	1.5														
			Condition Monitoring (Predictive	1.5														
			Testing)															
			Inspection	1.5														
			Instructions	1.7.1														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	1.9														
			Manuals															
			SD-11 Closeout Submittals															
			Record Drawings	1.3.1														
			Interim Form DD1354	1.11	G													
			Checklist for Form DD1354	1.11	G													
			NAVFAC Sustainable & Energy		G													
			Data Record Card															
		01 78 24.00 25	SD-10 Operation and Maintenance															
			Data															
			Training Plan		G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 78 24.00 25	Training Outline		G													
			Training Content		G													
			SD-11 Closeout Submittals															
			eOMSI, Progress Submittal	1.4.1	G													
			eOMSI, Prefinal Submittal	1.4.2	G													
			eOMSI, Final Submittal	1.4.3	G													
			Training Video Recording		G													
			Validation of Training Completion		G													
		02 41 00	SD-01 Preconstruction Submittals															
			Demolition Plan	1.2.1	G													
			Existing Conditions	1.10	G													
			SD-07 Certificates															
			Notification	1.6	G													
		03 30 00	SD-02 Shop Drawings															
			Reinforcing steel	1.6.2.3	G													
			SD-03 Product Data															
			Materials for curing concrete	2.4.7														
			Joint sealants	2.4.10														
			Joint filler	2.4.9														
			Recycled Aggregate Materials	2.4.3.3														
			Cement	2.4.1														
			Portland Cement	2.4.1.4														
			Ready-Mix Concrete	2.3.3														
			Bonding Materials	2.6														
			Concrete Curing Materials	2.3.4														
			Reinforcement	2.5														

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 00	Reinforcement Materials	1.6.2.1														
			Vapor barrier	2.4.6														
			Wood Forms	2.1.1														
			SD-04 Samples															
			Waterstops	2.2.1														
			Waterstops	2.4.10.3														
			SD-05 Design Data															
			mix design	2.3.2	G													
			SD-06 Test Reports															
			Concrete mix design	1.6.4.1	G													
			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														
			Tolerance report	3.10.2.1														
			Compressive strength tests	3.12.2.3														
			Air Content	3.12.2.4														
			Slump	2.3.2														
			Air Entrainment	2.3.2														
			SD-08 Manufacturer’s Instructions															
			Fly ash	1.6.4.2														
			Ground granulated blast-furnace	1.6.4.3														
			slag															
			Steel Bar	2.5.8														
		03 30 53	SD-02 Shop Drawings															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 53	Installation Drawings	1.4	G													
			SD-03 Product Data															
			Air-Entraining Admixture	2.2.3.1														
			Accelerating Admixture	2.2.3.2														
			Water-Reducing or Retarding	2.2.3.3														
			Admixture															
			Curing Materials	2.2.10														
			Joint Sealants															
			Chemical Floor Hardener	2.4.1														
			Mix Design Data	2.3	G													
			Ready-Mix Concrete	2.3														
			Burlap Backed Polyethylene															
			Sheet Moisture Retaining Cover															
			Curing Material															
			Mechanical Reinforcing Bar	2.2.5														
			Connectors															
			SD-06 Test Reports															
			Aggregates	2.2.2														
			Concrete Mixture Proportions	2.1.3	G													
			Measurement of Floor	3.3.3.2														
			Tolerances															
			Compressive Strength Testing	3.9.3	G													
			Slump	3.9.3	G													
			Air Content	3.9.3														
			Water	2.2.4														
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 53	Cementitious Materials	2.2.1														
			Pozzolan															
			Aggregates	2.2.2														
			Delivery Tickets	2.3														
			SD-08 Manufacturer’s Instructions															
			Chemical Floor Hardener	2.4.1														
			Curing Compound															
		05 12 00	SD-01 Preconstruction Submittals															
			Erection Drawings	1.3.1.1	G													
			SD-02 Shop Drawings															
			Fabrication drawings	1.3.2	G													
			SD-03 Product Data															
			Shop primer	2.6.2														
			Welding electrodes and rods	2.4.1														
			Non-Shrink Grout	2.4.2														
			Tension control bolts	2.3.3														
			SD-06 Test Reports															
			Bolts, nuts, and washers	2.3														
			Weld Inspection Reports	3.7.1.2														
			Bolt Testing Reports															
			SD-07 Certificates															
			Steel	2.2														
			Bolts, nuts, and washers	2.3														
			Galvanizing	2.5														
			Welding procedures and	1.3.3.1														
			qualifications															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 12 00	Welding electrodes and rods	2.4.1														
		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	G													
			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	G													
			Cant Strips	2.3.1.1	G													
			Ridge Plates	2.3.1.2	G													
			Metal Closure Strips	2.3.1.3	G													
			SD-03 Product Data															
			Accessories	2.2	G													
			Deck Units		G													
			Galvanizing Repair Paint	2.1.3.1	G													
			Galvanizing Repair Paint	2.1.6	G													
			Joint Sealant Material	2.1.5	G													
			Repair Paint	2.3.2	G													
			Welder Qualifications	1.3.3	G													
			Welding Equipment	1.3.3	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 30 00	Welding Rods and Accessories	1.3.3	G													
			SD-04 Samples															
			Metal Roof Deck Units		G													
			Flexible Closure Strips	2.1.7	G													
			Accessories	2.2	G													
			SD-05 Design Data															
			Deck Units		G													
			SD-07 Certificates															
			Welding Procedures	1.3.3														
			Fire Safety															
			Wind Storm Resistance	1.3.4.1														
		06 13 33	SD-02 Shop Drawings															
			timberwork	3.2.1														
			SD-06 Test Reports															
			Timber preservative inspection	1.4.2														
			Delivery inspection list	1.4.3														
			SD-07 Certificates															
			MSDS and CIS	1.4.1														
		07 21 23	SD-03 Product Data															
			Loose fill insulation	2.1														
			Certification															
			SD-08 Manufacturer's Instructions															
			Loose Fill Insulation	2.1														
		07 22 00	SD-03 Product Data															
			Fasteners	2.2	G													
			Insulation	2.1	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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)
		07 22 00	Certification																
			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	2.2															
			insulation	2.1															
		07 41 13	SD-02 Shop Drawings																
			Roofing Panels	1.4.5	G														
			Flashing and Accessories	1.4.5	G														
			Soffit Panels		G														
			SD-03 Product Data																
			Roof panels	2.1	G														
			Soffit Panels		G														
			Accessories	2.4	G														
			Fasteners	1.4.5	G														
			Pressure Sensitive Tape	1.4.5	G														
			Underlayments	2.7	G														
			Gaskets and Sealing/Insulating	2.8	G														
			Compounds																
			SD-04 Samples																
			Roof Panels	2.1	G														
			Factory-applied Color Finish	1.4.5	G														
			SD-05 Design Data																

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 41 13	Wind Uplift Resistance	1.2.1.2	G													
			SD-06 Test Reports															
			Leakage Test Report	1.2.1.1	G													
			Wind Uplift Test Report	1.2.1.2	G													
			Factory Finish and Color	2.2	G													
			Performance Requirements															
			SD-07 Certificates															
			Roof Panels	2.1	G													
			Coil stock compatibility	1.4.5	G													
			Qualification of Manufacturer	1.4.1	G													
			Qualification of Applicator	1.4.2	G													
			SD-08 Manufacturer’s Instructions															
			INSULATION	2.6	G													
			INSTALLATION MANUAL	1.4.5	G													
			SD-11 Closeout Submittals															
			Warranties	1.8	G													
			Information Card		G													
		07 60 00	SD-02 Shop Drawings															
			Fascias	3.1.11	G													
			Base flashing	3.1.10	G													
			Flashing at roof penetrations		G													
			Drip edge	3.1.12	G													
			Eave flashing	3.1.13	G													
		07 81 00	SD-03 Product Data															
			Fireproofing Material		G NVFA													
			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 81 00	Fire Resistance Rating		G NVFA													
		07 92 00	SD-03 Product Data															
			Sealants	2.1														
			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	G													
			Frames	2.5	G													
			Accessories	2.3														
			SD-03 Product Data															
			Doors	2.1	G													
			Frames	2.5	G													
			Accessories	2.3														
			Weatherstripping	2.6														
		08 71 00	SD-02 Shop Drawings															
			Hardware schedule	1.3	G													
			SD-03 Product Data															
			Hardware items	2.2	G													
			SD-08 Manufacturer’s Instructions															
			Installation	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Hardware Schedule	1.3	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 71 00	SD-11 Closeout Submittals															
			Key Bitting	1.4														
		09 90 00	SD-03 Product Data															
			Coating	2.1	G													
			Manufacturer's Technical Data	2.1														
			Sheets															
			SD-08 Manufacturer’s Instructions															
			Application instructions															
			Mixing	3.5.2														
			Manufacturer's Material Safety	1.5.2														
			Data Sheets															
			SD-10 Operation and Maintenance															
			Data															
			Coatings:	2.1	G													
		10 44 16	SD-01 Preconstruction Submittals															
			Manufacturer's Data	2.1														
			SD-02 Shop Drawings															
			Fire Extinguishers	2.1														
			Accessories															
			Wall Brackets															
			SD-03 Product Data															
			Fire Extinguishers	2.1														
			Accessories															
			Wall Brackets															
			Replacement Parts	3.2.1														
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 44 16	Fire Extinguishers	2.1														
			Manufacturer's Warranty with	2.1														
			Inspection Tag															
		23 00 00	SD-02 Shop Drawings															
			Detail Drawings	1.4.5	G													
			SD-03 Product Data															
			Manual Balancing Dampers	2.10.4	G													
			Diffusers	2.10.13.1														
			Registers and Grilles	2.10.13.5														
			Air Vents, Penthouses, and															
			Goosenecks															
			Air Handling Units		G													
			Room Fan-Coil Units		G													
			Diagrams		G													
			SD-06 Test Reports															
			Performance Tests	3.13	G													
			Damper Acceptance Test	3.11	G													
			SD-07 Certificates															
			Bolts															
			Certification	1.4.7														
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Installation	3.2														
			Instructions															
			Operation and Maintenance	3.15.2														
			Training															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 00 00	SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.15.1														
			Manuals															
			Manual Balancing Dampers	2.10.4	G													
			Air Handling Units		G													
			Room Fan-Coil Units		G													
		23 05 15	SD-01 Preconstruction Submittals															
			Material, Equipment, and Fixture	1.2														
			Lists															
			SD-02 Shop Drawings															
			Record Drawings	1.2														
			Connection Diagrams	1.2														
			Coordination Drawings	1.2														
			Fabrication Drawings	1.2														
			Installation Drawings	3.1														
			SD-03 Product Data															
			Pipe and Fittings	2.2														
			Valves	2.4														
			Supporting Elements	2.6														
			Equipment Foundation Data	1.2														
			SD-04 Samples															
			Manufacturer's Standard Color	1.2														
			Charts															
			SD-05 Design Data															
			Pipe and Fittings	2.2														

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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		DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		23 05 15	Valves	2.4															
			SD-06 Test Reports																
			Hydrostatic Tests	3.1															
			Air Tests	3.1															
			Valve-Operating Tests	3.1															
			Drainage Tests	3.1															
			Pneumatic Tests	3.1															
			Non-Destructive Electric Tests	3.1															
			System Operation Tests	3.1															
			SD-07 Certificates																
			Listing of Product Installations	1.2															
			Records of Existing Conditions	1.2															
			Surface Resistance	3.1															
			Shear and Tensile Strengths	3.1															
			Temperature Ratings	3.1															
			Bending Tests	3.1															
			Flattening Tests	3.1															
			Transverse Guided Weld Bend	3.1															
			Tests																
			SD-10 Operation and Maintenance																
			Data																
			Operation and Maintenance	3.12															
			Manuals																
		23 05 93	SD-01 Preconstruction Submittals																
			Records of Existing Conditions	1.3	G														
			Records of Existing Conditions	1.3.3	G														

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 05 93	TAB Firm	1.5.4.1	G													
			TAB team assistants	1.2	G													
			TAB team engineer	1.2	G													
			TAB Specialist	1.5.4.2	G													
			TAB team field leader	1.2	G													
			SD-02 Shop Drawings															
			TAB Schematic Drawings and	1.3.3	G													
			Report Forms															
			SD-03 Product Data															
			Equipment and Performance	1.3	G													
			Data															
			TAB Related HVAC Submittals	1.5.4.4	G													
			TAB Procedures	1.5.2	G													
			Calibration	1.5.2	G													
			Systems Readiness Check	1.3.3	G													
			TAB Execution	1.5.5	G													
			TAB Verification	1.5.5.3	G													
			SD-06 Test Reports															
			DALT and TAB Work Execution	3.7	G													
			Schedule															
			DALT and TAB Procedures	3.7	G													
			Summary															
			Design review report	1.3.3	G													
			Design review report	1.7.3.1	G													
			Design review report	3.7	G													
			Pre-Final DALT report	1.5.3	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 05 93	Pre-Final DALT report	1.7.3	G													
			Pre-Final DALT report	3.3.5	G													
			Final DALT report	1.5.3	G													
			Final DALT report	1.7.3	G													
			Final DALT report	3.3.8	G													
			TAB report	1.5.6.2														
			TAB report	3.7														
			SD-07 Certificates															
			Independent TAB agency and	1.5.1	G													
			personnel qualifications															
			Independent TAB agency and	1.5.1	G													
			personnel qualifications															
			Advance notice of Pre-Final	3.3.2	G													
			DALT field work															
			Completed Pre-Final DALT Work	3.7	G													
			Checklist															
			Completed Pre-Final DALT Work	3.7	G													
			Checklist															
			Advance Notice of TAB Field	3.7	G													
			Work															
			Completed Pre-TAB Work	3.7														
			Checklist															
			Completed Pre-TAB Work	3.7														
			Checklist															
			TAB Firm	1.5.4.1	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 05 93	DALT and TAB Submittal and	1.7.1	G													
			Work Schedule															
			DALT and TAB Submittal and	1.7.3	G													
			Work Schedule															
			Design review report	1.3.3	G													
			Design review report	1.7.3.1	G													
			Design review report	3.7	G													
			Pre-field DALT preliminary	1.7.3.2	G													
			notification															
			Pre-field TAB engineering report	1.7.3.3	G													
			Advanced notice for TAB field	1.7.3	G													
			work															
			Prerequisite HVAC Work Check	1.7.3	G													
			Out List															
		23 07 00	SD-02 Shop Drawings															
			MICA Plates	3.2.2.4	G													
			Pipe Insulation Systems	2.3														
			Pipe Insulation Systems	3.2														
			Duct Insulation Systems	3.3														
			Equipment Insulation Systems	3.4														
			SD-03 Product Data															
			Certification	1.4.2														
			Pipe Insulation Systems	2.3	G													
			Pipe Insulation Systems	3.2	G													
			Duct Insulation Systems	3.3	G													
			Equipment Insulation Systems	3.4	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 07 00	SD-04 Samples															
			Thermal Insulation	2.2.1.3	G													
			SD-08 Manufacturer's Instructions															
			Pipe Insulation Systems	2.3	G													
			Pipe Insulation Systems	3.2	G													
			Duct Insulation Systems	3.3	G													
			Equipment Insulation Systems	3.4	G													
		23 08 00.00 10	SD-02 Shop Drawings															
			Commissioning Plan	1.5.2.2	G													
			SD-03 Product Data															
			Pre-Functional Performance Test	3.2.1	G													
			Checklists															
			Functional Performance Tests	3.2.2	G													
			SD-06 Test Reports															
			Commissioning Report	3.3	G													
			SD-07 Certificates															
			Commissioning Firm	1.5.1	G													
			Commissioning Specialist	1.5.2	G													
		23 09 53.00 20	SD-02 Shop Drawings															
			Control system diagrams	1.7.1	G													
			Ladder diagram	1.7.2	G													
			Operating parameters	1.7.3	G													
			Automatic control valve	1.7.4	G													
			schedules															
			Damper schedules	1.7.5	G													
			Sequence of operation	1.7.8	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 09 53.00 20	Arrangement drawing	1.7.9	G													
			Wiring diagram	1.7.6	G													
			SD-03 Product Data															
			Actuators	2.2	G													
			Valves	2.3	G													
			Dampers	2.4	G													
			Fire protection devices	2.5	G													
			Sensors	2.6	G													
			Thermostats	2.8	G													
			Sunshields	2.9	G													
			Pressure switches	2.10.1	G													
			Indicating devices	2.11	G													
			Controllers	2.13	G													
			Pressure gages	2.12	G													
			Control panels	2.15	G													
			SD-06 Test Reports															
			Commissioning procedures	1.9.6	G													
			Calibration adjustment and	1.9.7	G													
			commissioning reports															
			Site testing procedures	1.9.5	G													
			Performance verification test	3.3.5	G													
			SD-07 Certificates															
			Certification of completion	3.3.4	G													
			SD-08 Manufacturer's Instructions															
			Training course documentation	3.4.1	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 09 53.00 20	SD-10 Operation and Maintenance															
			Data															
			Space temperature control	1.9.7	G													
			system															
			SD-11 Closeout Submittals															
			Qualified service organization list	3.5	G													
		23 23 00	SD-02 Shop Drawings															
			Refrigerant Piping System	2.3	G													
			SD-03 Product Data															
			Refrigerant Piping System	2.3														
			Spare Parts	1.5.2														
			Qualifications		G													
			Refrigerant Piping Tests	3.5	G													
			Demonstrations		G													
			Verification of Dimensions	3.1														
			SD-06 Test Reports															
			Refrigerant Piping Tests	3.5														
			SD-07 Certificates															
			Service Organization	2.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Maintenance	1.5														
			Operation and Maintenance															
			Manuals															
		23 31 13	SD-01 Preconstruction Submittals															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 31 13	Material, Equipment, and Fixture	1.5														
			Lists															
			Records of Existing Conditions	1.5														
			SD-02 Shop Drawings															
			Connection Diagrams	1.3														
			Connection Diagrams	1.6														
			Record Drawings	1.6														
			SD-03 Product Data															
			Equipment and Performance	1.2														
			Data															
			Galvanized Steel Ductwork	2.1.1														
			Materials															
			Brazing Materials	2.1.2														
			Mill-Rolled Reinforcing and	2.1.3														
			Supporting Materials															
			Round Sheet Metal Duct Fittings	2.2.1														
			Turning Vanes	2.2.5														
			Flexible Connectors	2.2.8														
			Flexible Connectors	2.2.8														
			Flexible Duct Materials	2.2.11														
			Gravity Backdraft and Relief	2.2.13														
			Dampers															
			Manual Volume Dampers	2.2.12														
			SD-05 Design Data															
			Design Analysis and Calculations	1.2														
			Design Analysis and Calculations	1.3														

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 31 13	SD-06 Test Reports															
			Ductwork Leakage Tests	3.4.2														
			Operational Tests															
			SD-07 Certificates															
			Listing of Product Installations	3.2														
			Galvanized Steel Ductwork	2.1.1														
			Materials															
			Brazing Materials	2.1.2														
			Mill-Rolled Reinforcing and	2.1.3														
			Supporting Materials															
			Round Sheet Metal Duct Fittings	2.2.1														
			Turning Vanes	2.2.5														
			Dampers	2.2.6														
			Flexible Connectors	2.2.8														
		23 37 13.00 40	SD-01 Preconstruction Submittals															
			Material, Equipment, and Fixture	2.1	G													
			Lists															
			Records of Existing Conditions	2.1	G													
			SD-02 Shop Drawings															
			Fabrication Drawings	2.1	G													
			Installation Drawings	3.1	G													
			SD-03 Product Data															
			Equipment and Performance	1.3	G													
			Data															
		23 82 02.00 10	SD-02 Shop Drawings															
			Drawings	1.4														

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 82 02.00 10	SD-03 Product Data															
			Materials and Equipment	2.1.1														
			Spare Parts	1.6														
			Posted Instructions	3.4														
			Verification of Dimensions	3.1														
			Coil Corrosion Protection	2.10.1.1														
			System Performance Tests	3.6														
			Demonstrations	3.4	G													
			SD-06 Test Reports															
			Refrigerant Tests, Charging, and	3.5	G													
			Start-Up															
			System Performance Tests	3.6	G													
			SD-07 Certificates															
			Materials and Equipment	2.1.1														
			Service Organization	2.1.1														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.4														
			Manuals															
		26 12 19.10	SD-02 Shop Drawings															
			Pad-mounted transformer	1.5.1	G													
			drawings															
			SD-03 Product Data															
			Pad-mounted transformers	2.2	G													
			SD-06 Test Reports															
			Acceptance checks and tests	3.6.1	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 12 19.10	SD-07 Certificates															
			Transformer Efficiencies	2.2.2.1	G													
			SD-09 Manufacturer's Field															
			Reports															
			design tests	2.6.2	G													
			routine and other tests	2.6.3	G													
			SD-10 Operation and Maintenance															
			Data															
			Transformer(s)	1.6.1	G													
			SD-11 Closeout Submittals															
			Transformer test schedule	2.6.1	G													
		26 20 00	SD-03 Product Data															
			Receptacles	2.14	G													
			Circuit breakers	2.13	G													
			Switches	2.12	G													
			Transformers	2.22.3	G													
			Enclosed circuit breakers	3.1.11	G													
			Motor controllers	2.22	G													
			Combination motor controllers	2.24.3	G													
			SD-06 Test Reports															
			600-volt wiring test	3.5.2	G													
			Grounding system test	3.5.5	G													
			SD-07 Certificates															
			Fuses	2.13	G													
			SD-10 Operation and Maintenance															
			Data															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 20 00	Electrical Systems	1.5.1	G													
		26 23 00	SD-02 Shop Drawings															
			Switchboard Drawings	1.5.2	G													
			SD-03 Product Data															
			Switchboard	2.2	G													
			SD-06 Test Reports															
			Switchboard design tests	2.5.2	G													
			Switchboard production tests		G													
			Acceptance checks and tests	3.5.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Switchboard Operation and	1.6.1	G													
			Maintenance															
			SD-11 Closeout Submittals															
			Assembled Operation and	1.6.2	G													
			Maintenance Manuals															
			Equipment Test Schedule	2.5.1	G													
			Request for Settings	3.5	G													
		26 27 14.00 20	SD-02 Shop Drawings															
			Installation Drawings	1.4.1	G													
			SD-03 Product Data															
			Electricity meters		G													
			Current transformer	2.1.3	G													
			Potential transformer	2.1.2	G													
			communications	2.2	G													
			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 27 14.00 20	Acceptance checks and tests	3.2.1	G													
			System functional verification	3.2.2	G													
			Completed meter data schedule	3.2.1	G													
			Meter configuration template	2.1.1	G													
			Meter configuration report	3.2.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Electricity Meters and	1.5.1	G													
			Accessories															
			SD-11 Closeout Submittals															
			System functional verification	3.2.2	G													
		26 36 23.00 20	SD-02 Shop Drawings															
			Automatic Transfer Switch	1.4.2	G													
			Drawings															
			SD-03 Product Data															
			Automatic Transfer Switches	2.1	G													
			SD-06 Test Reports															
			Acceptance Checks and Tests	3.3.1	G													
			Functional Acceptance Tests	3.3.2	G													
			SD-07 Certificates															
			Proof of Listing	1.4.1	G													
			SD-10 Operation and Maintenance															
			Data															
			Automatic Transfer Switches	2.1	G													
		26 51 00	SD-03 Product Data															
			Fluorescent lighting fixtures	2.1	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 51 00	Fluorescent electronic ballasts	1.6.1	G													
			Fluorescent lamps	2.1.3	G													
			High-intensity-discharge (HID)	2.2	G													
			lighting fixtures															
			HID ballasts	2.2.1	G													
			High-pressure sodium (HPS)	2.2.2	G													
			lamps															
			Low-pressure sodium lamps		G													
			Metal-halide lamps	2.2.3	G													
			Photocell switch	2.5	G													
			Exit signs	2.6	G													
			Emergency lighting equipment		G													
			Occupancy sensors		G													
		31 00 00	SD-01 Preconstruction Submittals															
			Dewatering Work Plan	1.6.3	G													
			SD-06 Test Reports															
			Testing	3.6														
			Borrow Site Testing	2.1														
			SD-07 Certificates															
			Testing	3.6														
		31 23 00.00 20	SD-01 Preconstruction Submittals															
			Dewatering work plan	1.7.1														
			SD-06 Test Reports															
			Fill and backfill	3.10.2.1														
			Porous fill	3.10.2.3														
			Density tests	3.10.2.4														

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 01 11.51	SD-04 Samples															
			paint removal	1.7.1														
			SD-07 Certificates															
			Schedule of work															
			High-pressure rubber and paint	1.8.1														
			removal equipment															
		32 01 17.16	SD-03 Product Data															
			Installation of Sealant	3.3														
			SD-04 Samples															
			Materials	1.5	G													
			SD-06 Test Reports															
			Test Requirements	1.5														
		32 01 19.61	SD-03 Product Data															
			Joint sealant	2.1.1														
			SD-04 Samples															
			Joint filler	3.1.1														
			Separating tape															
			backer rod															
			Joint sealant	2.1.1														
			SD-06 Test Reports															
			Joint sealant	2.1.1														
			SD-07 Certificates															
			Equipment list	1.6														
			SD-08 Manufacturer's Instructions															
			Joint sealant	2.1.1														
		32 01 19	SD-03 Product Data															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
							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	MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 01 19	Manufacturer's		G													
			Recommendations															
			Equipment	3.1														
			SD-04 Samples															
			Materials	1.3.1	G													
			SD-06 Test Reports															
			Certified copies of the test reports	1.3.1	G													
		32 01 29.61	SD-03 Product Data															
			Mix Design	2.1.4.1	G													
			Pigmented Liquid	2.1.5.2	G													
			Membrane-Forming Compound															
			Pigmented Liquid	2.1.5.2	G													
			Membrane-Forming Compound															
			SD-04 Samples															
			Absorbent curing material	3.6.3	G													
			Joint filler	2.1.8	G													
			Joint sealant	2.1.7	G													
			SD-05 Design Data															
			Concrete Mix Design	1.3.1	G													
			SD-06 Test Reports															
			Test Results	1.3.1														
			gradation	1.3.1.2														
			gradation	2.1.1.4														
			Cement	1.3.1.1														
			slump	2.1.4.1														
			air content	2.1.4.1														

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 01 29.61	strength	3.4.2														
			Mixer Calibration and Efficiency	1.3.2														
			SD-07 Certificates															
			Cement	1.3.1.1														
			Aggregate	1.3.1.2														
			Admixtures	2.1.3														
			Absorbent curing material	3.6.3														
			Pigmented Liquid	2.1.5.2														
			Membrane-Forming Compound															
			Pigmented Liquid	2.1.5.2														
			Membrane-Forming Compound															
			Waterproof Sheet	2.1.5.3														
			Joint Filler	2.1.8														
			Joint Sealant	2.1.7														
		32 11 23	SD-03 Product Data															
			Plant, Equipment, and Tools	2.1														
			Waybills and Delivery Tickets															
			SD-06 Test Reports															
			Sampling and Testing	1.4	G													
			Field Density Tests	1.4.2.4	G													
		32 12 10	SD-06 Test Reports															
			Sampling and Testing	3.7														
		32 12 15.13	SD-02 Shop Drawings															
			Placement Plan	1.4	G													
			SD-03 Product Data															
			Mix Design	2.3	G													

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 12 15.13	Contractor Quality Control	3.1	G													
			SD-04 Samples															
			Asphalt Cement Binder	2.2														
			Aggregates	2.1														
			SD-06 Test Reports															
			Aggregates	2.1	G													
			QC Monitoring	3.1.3.10														
			SD-07 Certificates															
			Asphalt Cement Binder	2.2	G													
			Testing Laboratory	3.7														
		32 12 36.19	SD-05 Design Data															
			Coal tar seal coat mix	1.5.1														
			SD-06 Test Reports															
			Coal tar	2.1.1														
			emulsion	3.2.5														
			Aggregate	3.2.4														
			SD-07 Certificates															
			Construction equipment	1.6.1														
		32 13 11	SD-03 Product Data															
			Equipment	2.9														
			Proposed Techniques	3.1.2	G													
			Dowels	2.7.1	G													
			Dowel Bar Assemblies	2.7.2	G													
			SD-05 Design Data															
			Proportioning Studies	2.11.2	G													
			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 13 11	Sampling and Testing	1.3.4	G													
			SD-07 Certificates															
			Contractor Quality Control Staff	1.5.1														
			Laboratory Accreditation	1.5.3														
			NRMCA Certificate of	2.9														
			Conformance															
			Commercial Laboratory	1.5.3														
		32 17 23.00 20	SD-03 Product Data															
			Reflective media for airfields	2.1.3														
			Paints for airfields	2.1.1														
			Equipment	1.5	G													
			Qualifications	1.8														
			SD-06 Test Reports															
			Reflective media for airfields	2.1.3														
			Paints for airfields	2.1.1														
			SD-07 Certificates															
			Reflective media for airfields	2.1.3														
			Paints for airfields	2.1.1														
			Construction equipment list	1.5														
			SD-08 Manufacturer’s Instructions															
			Paints for airfields	2.1.1														
		32 92 23	SD-03 Product Data															
			Fertilizer	2.5														
			SD-06 Test Reports															
			Topsoil composition tests	2.2.3														
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	
		32 92 23	sods	2.1															
		33 71 02	SD-02 Shop Drawings																
			Precast underground structures	1.4.1	G														
			SD-03 Product Data																
			Medium voltage cable	2.5	G														
			Medium voltage cable joints	2.7	G														
			Medium voltage cable	2.6	G														
			terminations																
			Precast concrete structures		G														
			Sealing Material																
			Pulling-In Irons																
			Manhole frames and covers		G														
			Handhole frames and covers		G														
			Frames and Covers for Airfield		G														
			Facilities																
			Ductile Iron Frames and Covers		G														
			for Airfield Facilities																
			Composite/fiberglass handholes		G														
			Cable supports	2.13	G														
			SD-06 Test Reports																
			Medium voltage cable	2.16.2	G														
			qualification and production tests																
			Field Acceptance Checks and	3.16.1	G														
			Tests																
			Arc-proofing test	2.16.1	G														

SUBMITTAL REGISTER

CONTRACT NO.
N69450-11-D-0071

TITLE AND LOCATION
NASCC BASE CLIN001

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/	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	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 71 02	Cable Installation Plan and	3.3	G													
			Procedure															
			SD-07 Certificates															
			Cable splicer/terminator	1.4.2	G													
			Cable Installer Qualifications	1.4.3	G													
			Certificate of Conformance	1.4.4	G													
		34 43 00.00 20	SD-03 Product Data															
			Materials and Equipment	2.1														
			Protection Plan	1.3.5														
			SD-06 Test Reports															
			Field Quality Control	3.15														
			Counterpoise system test	3.15.4														
			Visual Inspection	3.15														
			SD-07 Certificates															
			Installer Qualifications	1.3.3	G													
			Construction Outage Plan	1.3.4	G													
			Materials and Equipment	2.1														
			SD-10 Operation and Maintenance															
			Data															
			Constant current regulators	2.13														

SECTION 01 35 13.00 25

SPECIAL PROJECT PROCEDURES
12/14
NAVFAC SE VERSION

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. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 150/5300-13	(2012; Rev A; Change 1 2014) Airport Design
FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

1.2 DEFINITIONS

1.2.1 Landing Areas

"Landing Areas" means:

a. The primary surfaces, comprising the surface of the runway, runway shoulders, and lateral safety zones. The length of each primary surface is the same as the runway length. The width of each primary surface is 2000 feet (1000 feet on each side of the runway centerline).

b. The "clear zone" beyond the ends of each runway is the extension of the primary surface for a distance of 1000 feet beyond each end of each runway.

c. All taxiways, plus the lateral clearance zones along each side for the length of the taxiways (the outer edge of each lateral clearance zone is laterally 250 feet from the far or opposite edge of the taxiway (example: a 75 foot widetaxiway must have a combined width and lateral clearance zone of 425 feet.)

d. All aircraft parking aprons, plus the area 125 feet in width extending beyond each edge all around the aprons.

1.2.2 Safety Precaution Areas

“Safety Precaution Areas” means those portions of approach-departure clearance zones and transitional zones where placement of objects incident to contract performance might result in vertical projections at or above the approach-departure clearance, or the transitional surface.

a. The “approach-departure clearance surface” is an extension of the primary surface and the clear zone at each end of each runway, for a distance of 50,000 feet, first along an inclined (glide angle) and then along a horizontal plane, both flaring symmetrically about the runway centerline extended.

1. The inclined plane (glide angle) begins in the clear zone 200 feet past the end of the runway (and primary surface) at the same elevation as the end of the runway. It continues upward at a slope of 50:1 (1 foot vertically for each 50 feet horizontally) to an elevation of 500 feet above the established airfield elevation. At that point the plane becomes horizontal, continuing at that same uniform elevation to a point 50,000 feet longitudinally from the beginning of the inclined plane (glide angle) and ending there.

2. The width of the surface at the beginning of the inclined plane (glide angle) is the same as the width of the clear zone. It then flares uniformly, reaching the maximum width of 16,000 feetat the end.

b. The “approach-departure clearance zone” is the ground area under the approach-departure clearance surface.

c. The “transitional surface” is a sideways extension of all primary surfaces, clear zones, and approach-departure clearance surfaces along inclined planes.

1. The inclined plane in each case begins at the edge of the surface.

2. The slope of the incline plane is 7:1 (1 foot vertically for each 7 feet horizontally). It continues to the point of intersection with the either "a" or "b" as defined below:

(a) Inner horizontal surface (which is the horizontal plane 150 feet above the established airfield elevation); or

(b) Outer horizontal surface (which is the horizontal plane 500 feet above the established airfield elevation), whichever is applicable.

d. The “transitional zone” is the ground area under the transitional surface. (It adjoins the primary surface, clear zone, and approach-departure clearance zone.)

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Heavy Equipment and Vehicle List Existing Conditions Survey

Construction Operations Plan

Safety Plan

Schedule of Work

PART 2 PRODUCTS

2.1 AIRFIELD OBSTRUCTION LIGHTS

Airfield obstruction lights must conform to FAA AC 70/7460-1 and have red or white lenses.

PART 3 EXECUTION

3.1 HAZARDS TO AIRFIELD OPERATION

In addition to "DFARS 252.236-7005, Airfield Safety Precautions," the following paragraphs apply.

3.1.1 Work in Proximity to Landing Areas,Landing Strips,Landing Pad(s)

Place nothing upon the landing area or applicable portions of safety precaution areas without authority of the Contracting Officer.

Use of landing areas,landing strips, and landing pads for purposes other than aircraft operation,is prohibited without permission of the Contracting Officer, and the landing arealanding striplanding pad is closed by order of the Contracting Officer and marked as indicated herein.

Accomplish all construction work on the runways, and taxiways, and in the end zones of the runways and 75 feet to each side of the runways and taxiways with extreme care regarding the operation of aircraft. Cooperate closely, and coordinate with the Contracting Officer. Park equipment in an area designated by the Contracting Officer. Parking of equipment, vehicles, or any type of storage overnight or for any extended period of time in the proximity of the is strictly prohibited. Leave no material in areas where extreme care is to be taken regarding the operation of aircraft.

During periods of active performance of work on the airfield by the Contractor, govern all operations of mobile equipment per the safety provisions.

3.1.2 Schedule of Work/Aircraft Operating Schedules

Schedule work to conform to aircraft operating schedules. The Government will exert every effort to schedule aircraft operations so as to permit the maximum amount of time for the Contractor's activities; however, in the event of emergency, intense operational demands, adverse wind conditions, and other such unforeseen difficulties, the Contractor must cease operations at the specified locations in the aircraft operational area for the safety of the Contractor and military personnel and Government property. Submit a schedule of the work to the Contracting Officer for transmittal to the Operations Officer describing the work to be accomplished; the location of the work, noting distances from the ends of landing areas, taxiways and buildings and other structures as necessary; and dates and hours during which the work is to be accomplished. Keep the approved schedule of work current, and notify the Contracting Officer of any changes prior to beginning each day's work.

Prior to commencement of work, submit the following to the Contracting Officer :

Existing Conditions Survey
Construction Operations Plan

Where flying is controlled, additional permission must be obtained from the control tower operator to enter a landing area unless such area is marked as hazardous to aircraft.

3.1.3 Daytime Markings

During daylight, mark stationary and mobile equipment with international orange and white checkered flags, mark the material, and work with yellow flags.

Vehicles operating in the landing area, must be identified by means of a flag on a staff attached to and flying above the vehicle. Flag size must be not less than 3 feet square and consist of a checkered pattern of international orange and white squares not less than 1 foot on each side. Flags varying in any dimension by not more than 10 percent of the specified dimensions are considered to comply with the stated requirements.

3.1.4 Nighttime Markings

During nighttime, which begins 2 hours before sundown and ends 2 hours after sunrise, mark stationary and mobile equipment and material, and work with battery-operated, low-intensity, red flasher lights. Where the Operations Officer determines that the red flasher lights may confuse pilots approaching for landings, the Operations Officer may direct that the red flasher lights be left off or that the color of the lights be changed.

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.

No separate payments will be made for lighting and protection necessitated by the safety provisions.

3.1.5 Excavation

Open only those trenches for which material is on hand and ready for placing therein. As soon as possible after the material has been placed and work approved, backfill and compact the trenches as specified.

Maintain landing areaslandings stripslanding pads at all times free from hazards, holes, material piles, or projecting shoulders that might damage tires or landing gear. Paved surfaces must be kept clean at all times and free from small stones or other objects which could cause damage to propellers, craft, and personnel.

3.1.6 Contractor Safety Precautions

The Contractor is advised that aircraft operations will produce extremely high noise levels and will induce vibrations in pavements, structures, and equipment in the vicinity, and may result in high velocity flying debris in the area. The Contractor is responsible for providing all necessary protective eye and ear gear and other safety devices for his personnel, for insuring protection of his equipment, and for scheduling the work to eliminate hazards to his personnel and equipment and to prevent damage to work performed by him.

Boundary areas for hazardous work locations and restrictions are defined in FAA AC 150/5300-13. Construction activity within the limits of the boundary areas without approval of the Contracting Officer is prohibited.

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level.

3.1.7 Base Civil Engineering (BCE) Work Clearance Request

Obtain an approved BCE Work Clearance Request, AF Form 103, prior to the start of excavation, digging work, or work that disrupts aircraft or vehicular traffic flow, base utility services, fire and intrusion alarm system, or routine activities of the Activity.

3.1.8 Radio Contact

Provide necessary battery powered portable radios, including one radio for the tower. During work within the landing area, have an operator (who speaks fluent English) available for radio contact with the tower at all times. Radio frequency must be approved by the tower.

The Contractor shall provide personnel to serve as radio equipped driver escorts and crossing guards at haul roads that cross active taxiways. All airfield drivers and crossing guards shall be trained in the use of airfield radios and communication with Air Traffic Control (ATC). Training is provided by the airfield staff, is approximately 4 hours and requires passage of a test administered by the airfield staff. Drivers and guards shall be able to communicate clearly with ATC and be able to observe and understand light gun signals from the ATC Tower.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 35 26.00 25

GOVERNMENTAL SAFETY REQUIREMENTS
03/15
NAVFAC SE VERSION

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 SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	(2012) Fall Protection
ASSE/SAFE A10.34	(2001; R 2012) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22	(2010) Articulating Boom Cranes
ASME B30.3	(2012) Tower Cranes
ASME B30.5	(2011) Mobile and Locomotive Cranes
ASME B30.8	(2010) Floating Cranes and Floating Derricks

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2013) Standard for Portable Fire Extinguishers
NFPA 241	(2013) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 51B	(2014) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

NFPA 70E	(2015) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 2011) 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 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1400	Cranes and Derricks in Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.500	Fall Protection
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

NAVFAC P-307	(2009; Change 1 Mar 2011; Change 2 Aug 2011)Management of Weight Handling Equipment

1.2 DEFINITIONS

a. Competent Person for Fall Protection. One who can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel and who as authorization to take prompt corrective measures to eliminate them.

b. High Visibility Accident. Any mishap which may generate publicity or high visibility, or is deemed high visibility by the Authority Having Jurisdiction.

c. 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.

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

e. Qualified Person. One who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems related to the subject matter, the work, or the project.

f. 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 (any time lost after day of injury/illness onset);

(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.

g. Near Miss. A recognized hazard that was corrected, avoided potential accident, or a minor incident with no injury or damage that was "on the spot" corrected. Self-report near misses to Contracting Officer. Near miss reports are used by Contracting Officer for Operational Risk Management purposes and are not held against the Contractor for evaluation purposes.

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

i. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the multiple 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; or collision, including unplanned contact between the load, crane, 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.) Document any mishap meeting the criteria described above in both the Contractor Significant Incident Report (CSIR) and using the NAVFAC prescribed Navy Crane Center (NCC) form submitted within five days both as provided by the Contracting Officer. Comply with additional requirements and procedures for accidents in accordance with NAVFAC P-307, Section 12.

j. Rigging Gear. A suspended load is supported by rigging gear from either a crane, alternate machine, or fixed/portable structure with a pulley like device that acts to support movement and change of

direction to the suspended load. Rigging gear shall comply with additional requirements and procedures in accordance with the latest revision of document NAVFAC P-307, Section 14 and Appendix P, Figure P-1 Certificate of Compliance.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G

Activity Hazard Analysis (AHA); G

Crane Critical Lift Plan; G

Proof of qualification for Crane Operators; G

OSHA Days Away from Work, Restricted Duty, or Job Transfer (DART) Rate; G

Experience Modification Rate (EMR); G

SD-06 Test Reports

Notifications and Reports

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

Accident Reports; G

Crane Reports

SD-07 Certificates

Confined Space Entry Permit

Hot work permit

License Certificates

Contractor Safety Self-Evaluation Checklist; G

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

SD-11 Closeout Submittals

OSHA Form 300A "Summary of Work-Related Injuries and Illnesses"

OSHA Form "Calculating Injury and Illness Incidence Rates"

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. Complete the checklist monthly and submit 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 may result in retention of up to 10 percent of the voucher. Additionally, provide a Monthly Exposure Report and attach to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. Failure to submit the report may result in retention of up to 10 percent of the voucher. The Contracting Officer will submit a copy of the Contractor Safety Self-Evaluation and Monthly Exposure Report to the local safety and occupational health office.

1.5 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent edition of USACE EM 385-1-1, and federal, state, and local 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 govern.

1.5.1 Subcontractor Safety Requirements

Neither Contractor nor any subcontractor shall enter into contract with any subcontractor who fails to meet the following requirements. The term subcontractor in the following paragraphs shall mean all subcontractors on the project, whether in contract with the Contractor or any subcontractor.

At least five days before any new subcontractor starts work, or at least five days prior to the preparatory meeting regarding the subcontractor's work, whichever is earlier, Contractor shall submit subcontractor's proof of compliance with requirements detailed below for Experience Modification Rate and DART rates, for Government approval.

1.5.1.1 Experience Modification Rate (EMR)

No subcontractor on the project shall have an effective EMR greater than 1.10 when entering into a subcontract agreement with the prime contractor or a subcontractor at any tier as computed by the National Council on Compensation Insurance (NCCI) or if not available, as computed by the state agency's rating bureau in the state where the subcontractor is registered. Prime Contractor may submit a written request for additional consideration to the Contracting Officer where the specified acceptable EMR range cannot be achieved for a particular subcontractor whose performance is uniquely critical to the construction project. Relaxation of the EMR range shall only be considered and/or granted on a case-by-case basis for special conditions and shall not be anticipated as tacit approval. Contractor's Site Safety and Health Officer (SSHO) shall collect and maintain certified EMR ratings for ALL subcontractors on the project and shall make them available to the Government at the Government's request.

a. For subcontractors with an effective EMR between 1.0 and 1.1, Prime Contractor shall submit a plan to monitor the safety of those

subcontractors during contract performance, highlighting what specific management practices will be in place for providing deliberate safety program management and mishap prevention.

1.5.1.2 OSHA Days Away From Work, Restricted Duty, or Job Transfer (DART) Rate

No subcontractor on the project shall have a DART rate calculated from the most recent, complete calendar year greater than 3.0 when entering into a subcontract agreement with the prime contractor or a subcontractor at any tier. If during any of the last five (5) complete calendar years, proposed subcontractor has a DART rate greater than 2.0, Prime Contractor must submit an explanation of extenuating circumstances that adversely affected the DART rate, acceptable to the Contracting Officer. If accepted, Prime Contractor shall further submit a plan to monitor the safety of those subcontractors during contract performance, highlighting what specific management practices will be in place for providing deliberate safety program management and mishap prevention.

The OSHA Dart Rate is calculated using the following formula:

(N/EH) x 200,000
where

N = number of injuries and/or illnesses with days away, restricted work, or job transfer
EH = total hours worked by all employees during most recent, complete calendar year
200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year)

Prime Contractor may also submit a written request for additional consideration to the Contracting Officer where the specified acceptable OSHA Dart rate range cannot be achieved for a particular subcontractor whose performance is uniquely critical to the construction project. Relaxation of the OSHA DART Rate range shall only be considered and/or granted on a case-by-case basis for special conditions and shall not be anticipated as tacit approval. If Contracting Officer rejects any subcontractor based upon the criteria listed herein, Prime Contractor shall provide an alternate subcontractor to complete the work at no additional cost or time impact to the Contract. Contractor's Site Safety and Health Officer (SSHO) shall collect and maintain self-certified OSHA DART rates for ALL subcontractors on the project and shall make them available to the Government at the Government's request.

1.6 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

The SSHO must meet the requirements of EM 385-1-1 section 1 and ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Designated Representative/alternate must be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO's training, experience, and qualifications must be as required by

EM 385-1-1 paragraph 01.A.17, entitled SITE SAFETY AND HEALTH OFFICER (SSHO), and all associated sub-paragraphs.

Provide a Competent Person for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, who must be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the Contracting Officer for acceptance in consultation with the Safety Office.

1.6.1.1.1 Contractor Quality Control (QC) Person:

The Contractor Quality Control Person cannot be the SSHO on this project, even though the QC has safety inspection responsibilities as part of the QC duties.

1.6.1.2 Competent Person for Confined Space Entry

Provide a "Competent Person" to supervise the entry into each confined space. That individual must meet the requirements and definition of Competent Person as contained in EM 385-1-1.

1.6.1.3 Crane Operators and Hoisting Equipment Operators

Meet the crane operators requirements in USACE EM 385-1-1, Section 16 and Appendix I. Meet the equipment operators requirements in USACE EM 385-1-1, Sections 16.S and 16.V for hydraulic excavators, wheel/track/backhoe loaders, multi-purpose machines, and material handling equipment. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification. In addition, comply with Contractor Operated Crane Requirements included in the latest revision of document NAVFAC P-307 Section 1.7.2 "Contractor Operated Cranes," and Appendix P, Figure P-1 and with 29 CFR 1926, Subpart CC.

1.6.2 Personnel Duties

1.6.2.1 Site Safety and Health Officer (SSHO)

The SSHO will:

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. Attach safety inspection logs to the Contractors' daily production report.

b. Conduct mishap investigations and complete required reports. Maintain one OSHA Form 300 "Log of Work-Related Injuries and Illnesses" and one OSHA Form 300A "Summary of Work-Related Injuries and Illnesses", and document safety oversight work in the Daily Production reports for prime and all sub-contractors. Update OSHA Form 300A on a monthly basis and post it at the Contractor's construction trailer throughout the construction period. Submit final OSHA Form 300A along with OSHA Form "Calculating Injury and Illness Incidence Rates" which includes the Total Recordable Cases Incidence Rate and DART Incidence Rate, at

project closeout.

c. Collect and maintain certified EMR ratings and DART rates for all subcontractors on the project and make them available to the Government at the Government's request.

d. Maintain Daily Production Reports for prime and subcontractors.

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

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

g. Implement and enforce accepted APPS and AHAs.

h. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.

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

j. Maintain a list of hazardous chemicals on site and their material safety data sheets.

k. Ensure "near miss" hazardous conditions are promptly and permanently corrected or that hazards which cannot be on-the-spot corrected are marked, barricaded, guarded or temporarily fixed to reduce hazard. Self report near misses to Contracting Officer using electronic NAVFAC SE "Near Miss" form provided at the Preconstruction Conference - Safety Meeting.

Superintendent, QC Manager, and/or SSHO are subject to dismissal if the above duties are ot being effectively carried out. If Superintendent, QC Manager, and/or SSHO are dismissed, project work will be stopped and will not be resumed until a suitable replacement is approved and the above duties are again being effectively carried out..

1.6.3 Meetings

1.6.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project must 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).

b. 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, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of

the Contractor at the preconstruction conference, and the Contractor must revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.6.3.2 Safety Meetings

Conduct safety meetings to review past activities, plane for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors on the project location and at least a week for all workers by SSHO, supervisors, foreman or Collateral Duty Safety Officer's (CDSO's). Document meetings, including the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation and furnish copies to the Government Designated Authority (GDA) on request. Inform the GDA of all scheduled meetings in advance and invite to attend.

1.7 ACCIDENT PREVENTION PLAN (APP)

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 Accident Prevention Plan". Specific requirements for some of the APP elements are described below. The APP must be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP must interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP 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 must 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, the Contractor Quality control Manager, and any designated CSP 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.

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, make changes to the accepted APP with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors,

the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the Contracting Officer's office and at the job site.
Continuously review and amend the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.7.1 EM 385-1-1 Contents

In addition to the requirements outlined 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. Specify the duties of each position.

b. Qualifications of competent and of qualified persons. As a minimum, designate and submit qualifications of competent persons 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 and/or enclosed space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, 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. Crane Critical Lift Plan. Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane, hoist or alternate machine (or lifts over 50 percent of the capacity of a floating crane/derrick, crane barge, or auxiliary shipboard mounted crane) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; lifts without the use of outriggers using rubber tire load charts; lifts involving submerged loads and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. Submit 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.H. and the following:

(1) For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400.

(2) For floating cranes/derricks, crane barges, and auxiliary shipboard mounted cranes, comply with requirements in EM 385-1-1 Section 16.L, as revised in Change 6 2011.

e. Fall Protection and Prevention (FP&P) Program Documentation. The program documentation must be site specific and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A qualified person for fall protection must prepare and sign the program documentation. 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. Revise the Fall Protection and Prevention Program documentation every six monthsfor lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Program documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Program documentation in the Accident Prevention Plan (APP).

Incude a Rescue and Evacuation Plan in the FP&P Plan in accordance with USACE EM 385-1-1, Section 21.M. Include in the plan 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. Include the Rescue and Evacuation Plan in the Fall Protection and Prevention (FP&P) Plan, and as part of the Accident Prevention Plan (APP).

f. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00 DEMOLITION and referenced sources. Include engineering survey as applicable.

g. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 00 00 EARTHWORK.

1.8 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format must be in accordance with USACE EM 385-1-1, Section 1. Submit the AHA for review at least 15 calendar days prior to the start of each activity, task or Defined Feature of Work (DFOW). Format subsequent AHAs as amendments to the APP. Use the analysis 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.

Identify each major phase of work that will be performed on this contract. With each major phase, all activities, tasks or DFOW must be identified that require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

Prepare an AHA specific to transporting or hoisting operation for alternate machine lifts.

1.9 DISPLAY OF SAFETY INFORMATION

Within one calendar day after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do

not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, will meet the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, section 01.A.06. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

1.10 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.

1.11 EMERGENCY MEDICAL TREATMENT

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

1.12 NOTIFICATIONS and REPORTS

1.12.1 Accident Notification

Notify the Contracting Officer as soon as practical, but no more 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 $5,000, or any weight handling equipment accident. Within notification 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.

1.12.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, property damage accidents resulting in at least $20,000 in damages, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable NAVFAC Contractor Incident Reporting System (CIRS), and electronically submit via the NAVFAC Enterprise Safety Applications Management System (ESAMS. The Contracting Officer will provide copies of any required or special forms.

b. Near Misses: Report to the applicable GDA all near-misses that occur during the contract timeframe, through the electronic format provided by the GDA.

c. Conduct an accident investigation for any weight handling equipment accident (including rigging gear accidents) 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. Do not proceed with crane operations 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.

1.12.3 Crane Reports

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

1.12.4 Certificate of Compliance

Provide a Certificate of Compliance for each crane or alternate machine used to lift a suspended load, and rigging gear used with a suspended load, entering an activity under this contract (see Contracting Officer for a blank certificate) per NAVFAC P-307, Appendix P, Figure P-1. State within the certificate that the equipment 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 comply with 29 CFR 1926 and USACE EM 385-1-1 Section 16 and Appendix I. Certify on the Certificate of Compliance that the operator(s) is qualified and trained in the operation of the equipment to be used. Also certify that all of its operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). Post certifications on the crane.

1.13 HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the Fire Division. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers must 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 must be trained in accordance with NFPA 51B and remain on-site for a minimum of 60 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes. REPORT ANY FIRE, NO MATTER HOW SMALL, TO THE RESPONSIBLE FIRE DIVISION IMMEDIATELY.

1.14 FACILITY OCCUPANCY CLOSURE

Do not close or obstruct streets, walks, and other facilities occupied and used by the Government without written permission from the Contracting Officer.

1.15 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must comply with the station storm plan and:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.16 CONFINED SPACE ENTRY REQUIREMENTS.

Comply with the requirements in Section 34 of USACE EM 385-1-1, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, OSHA Directive CPL 2.100 and OSHA 29 CFR 1926. 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 34 of USACE EM 385-1-1 for entry procedures.) Review all hazards pertaining to the space 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 regardless of classification.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxix gas detection in addition to continuous forced air ventilation regardless of space classification.

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE

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

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with USACE EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be carried/available on each person.

Madatory PPE includes:

a. Hard Hat

b. Appropriate Safety Shoes

c. Reflective Vests

3.1.1 Worksite Communications

Provide employees working alone in a remote location or away from other workers an effective means of emergency communications (i.e., cellular phone, two-way radios, land-line telephones or other acceptable means). The selected communication must be readily available (easily within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment. Develop an employee check-in/check-out procedure to ensure employee safety.

3.1.2 Hazardous Material Use

Each hazardous material must receive approval from the Contracting Office or their designated representative 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.

3.1.3 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. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.4 Unforeseen Hazardous Material

Contract documents identify materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material(s) that may be hazardous to human health upon disturbance are encountered during demolition, repair, renovation or construction operations, 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

Apply for utility outages no more than 15 working 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, 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 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program 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 evacuation procedures in accordance with ASSE/SAFE Z359.1.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.B.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21. 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 21.N through 21.N.04. 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 are 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, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components must meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support 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 must 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 carabineers may be used. Make webbing, straps, and ropes of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 6 feet. The total fall distance and any swinging

of the worker (pendulum-like motion) that can occur during a fall should always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 6 feet of an edge, on a roof having a slope less than or equal to 4:12 (vertical to horizontal), protect personnel 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 6 feet from an edge, erect and install warning lines in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.

3.4.4 Horizontal Lifelines

Design, install, certify, and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.4.6 Rescue and Evacuation Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan 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. Include the Rescue and Evacuation Plan within 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).

3.5 SCAFFOLDING

Provide employees 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 scaffold platforms greater than 20 feet maximum in height by use of a scaffold stair system. Do not use vertical ladders commonly provided by scaffold system manufacturers for accessing scaffold platforms greater than 20 feet maximum in height. The use of an adequate gate is required. 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. Give special care to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited. The first tie-in should be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Place work platforms on mud sills. Scaffold or work platform erectors must 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.

3.6 EQUIPMENT

3.6.1 Rigging Gear and Miscellaneous Equipment

a. Rigging gear and miscellaneous equipment for suspended loads must meet NAVFAC P-307, Appendix P, Figure P-1.

3.6.2 Material Handling Equipment

a. Material handling equipment such as forklifts may 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. Additionally, when material handling equipment is used as a crane it must meet NAVFAC P-307 requirements in Sections 1.7.2, "Contractor Operated Cranes," and 12, "Investigation and Reporting of Crane and Rigging Gear Accidents."

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

3.6.3 Weight Handling Equipment

a. Equip cranes and hoisting equipment as specified in EM 385-1-1, section 16.

b. 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 will remain with the crane during the spot check.

c. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

d. 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. Under no circumstance may a Contractor make a lift at or above 90 percent of a mobile crane's rated capacity or 76 percent of a

non-mobile crane's rated capacity in any configuration.

f. When operating in the vicinity of overhead transmission lines, operators and riggers must be alert to this special hazard and follow the requirements of USACE EM 385-1-1 Section 11, NAVFAC P-307 Figure 10-3 and ASME B30.5 or ASME B30.22 as applicable.

g. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

h. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

i. All employees must keep clear of loads about to be lifted and of suspended loads.

j. Use cribbing when performing lifts on outriggers.

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

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

m. 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 or alternate machine that was inspected must always be available for review by Contracting Officer personnel.

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

o. Certify that all operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

p. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. Prior to conducting lifting operations set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site. Include this maximum wind speed determination as part of the activity hazard analysis plan for that operation.

3.6.4 Equipment and Mechanized Equipment

a. Proof of qualifications for operator must be kept on the project site for review.

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

c. Machinery and Mechanized Equipment are subject to additional Navy proof of certification. A certification form for acceptance by the

Contracting Officer prior to being placed into use may be required.

3.6.5 USE OF EXPLOSIVES

Explosives may not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval does not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, must be only where directed and in approved storage facilities. These facilities must be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

3.7 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

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.

3.7.2 Utility Location Verification

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.

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

Utilities located within and under concrete slabs or pier structures, 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 may 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.

3.8 ELECTRICAL

Submit Electrical Work Request and Electrical AHA 15 days prior to work commencing. Submittals shall comply with NFPA 70E, IEEE C2, and EM 385-1-1 requirements.

3.8.1 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for

the tool to be powered and protected from damage. Immediately remove from service all damaged extension cords. Meet the requirements of EM 385-1-1, NFPA 70E, and OSHA electrical standards.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 35 40.00 20

ENVIRONMENTAL MANAGEMENT
02/10

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 within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z400.1	(2004) Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation

ASTM INTERNATIONAL (ASTM)

ASTM D 4840	(1999; R 2010) Sampling Chain-Of-Custody Procedures
ASTM E 2114	(2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

NPDES	(1972; R 2005) National Pollutant Discharge Elimination System

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

40 CFR 261	Identification and Listing of Hazardous Waste

1.2 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E 2114 and as specified.

a. "Chain-of-custody" is a process whereby a product or material is maintained under the physical possession or control during its entire life cycle.

b. "Pollution and environmental damage" is caused by the presence of chemical, physical, or biological elements or agents. Human health or welfare is adversely affected; ecological balances are unfavorably altered; the utility of the environment for aesthetic, cultural, or historical purposes degrades.

1.3 PRECONSTRUCTION MEETING

After award of Contract and prior to commencement of the work, the Contractor shall schedule and conduct a meeting with the Contracting Officer to discuss the proposed Environmental Protection Plan and to develop a mutual understanding relative to the details of environmental

protection. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting as specified in Section 01 45 00.00 25 QUALITY CONTROL.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G

Instructor Qualifications

Submit reference data to demonstrate instructors' individual and firm's capabilities and experience.

SD-06 Test Reports

Field Quality Control Reports

SD-07 Certificates

Environmental Regulatory Requirements

For Government's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with environmental regulations bearing on performance of the work.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-11 Closeout Submittals

Protection of Natural Resources

1.5 CONTRACTOR'S ENVIRONMENTAL MANAGER

Designate an on-site Environmental Manager responsible for overseeing the environmental goals for the project and implementing procedures for environmental protection.

1.5.1 Duties

The Environmental Manager shall be responsible for the following:

a. Compliance with applicable federal, state, and local environmental regulations, including maintaining required documentation.

b. Implementation of the Waste Management Plan.

c. Implementation of the Indoor Air Quality (IAQ) Management Plan.

d. Implementation of the Environmental Protection Plan.

e. Environmental training for Contractor personnel in accordance with their position requirements.

f. Monitoring and documentation of environmental procedures.

1.5.2 Qualifications

Minimum 5 years construction experience on projects of similar size and scope; minimum 2 years experience with environmental procedures similar to those of this project; familiarity with Environmental Management Systems (EMSs); familiarity with environmental regulations applicable to construction operations.

1.6 ENVIRONMENTAL REGULATORY REQUIREMENTS

The Contractor shall be responsible for knowing federal, state, and local regulatory requirements pertaining to legal disposal of all construction and demolition waste materials. Comply with all applicable regulations and maintain records of permits, licenses, certificates, and other environmental regulatory requirement correspondences.

1.7 ENVIRONMENTAL REQUIREMENTS FOR PRODUCTS

1.7.1 Material Safety Data Sheets (MSDS)

Submit an MSDS for each product specified in other sections or required by OSHA to have an MSDS. MSDS shall be prepared . Include information for MSDS Sections 1 through 16 in accordance with ANSI Z400.1 and as follows:

a. Section 11: Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. Provide written description of the process used in evaluating chemical hazards relative to preparation of the MSDS.

b. Section 12: Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in the event of an accidental release.

c. Section 13: Include data regarding the proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according to 40 CFR 261.

d. Section 14: Identify hazard class for shipping.

e. Section 15: Identify federal, state, and local regulations applicable to the material.

f. Section 16: Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts. Identify the date MSDS was prepared.

1.8 ENVIRONMENTAL PROTECTION PLAN

Prepare and submit an Environmental Protection Plan not less than 10 days before the preconstruction meeting. At a minimum, address the following elements in accordance with this section:

a. Identification and contact information for Environmental Manager.

b. General site information, including preconstruction description and photographs.

c. Summary of training program.

d. Procedures to address water resources.

e. Procedures to address land resources.

f. Procedures to address air resources.

g. Procedures to address fish and wildlife resources.

h. Monitoring and quality control procedures.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

1.9 ENVIRONMENTAL DEMONSTRATION AND TRAINING

Contractor shall provide environmental training for workers performing work on the project site.

1.9.1 Instructor Qualifications

Training shall be given by a firm or individual experienced in providing training or education similar in content and extent to that indicated for this project.

1.9.2 Coordination

Coordinate instruction schedule with Government operations. Adjust schedule as required to minimize disruption of Government operations. Coordinate instruction with demonstration and training of general building systems.

PART 2 PRODUCTS

2.1 ENVIRONMENTALLY PREFERABLE PRODUCTS

Consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and disposal of products, and provide products and materials with the least effect on the environment, determined by LCA analysis, released toxins, and other methods.

2.1.1 Prohibited Materials

The use of the following materials is prohibited:

a. Products containing asbestos.

b. Products containing urea formaldehyde.

c. Products containing polychlorinated biphenyls.

d. Products containing chlorinated fluorocarbons.

e. Solder or flux containing more than 0.2 percent lead and domestic water pipe or pipe fittings containing more than 8 percent lead.

f. Paint containing more than 0.06 percent lead.

2.1.3 Substitutions

Notify the Contracting Officer when Contractor is aware of materials, equipment, or products that meet the aesthetic and programmatic intent of Contract Documents, but which are more environmentally responsible than materials, equipment, or products specified or indicated in the Contract Documents. Submit the following for initial review by the Contracting Officer:

a. Product data including manufacturer's name, address, and phone number.

b. Description of environmental advantages of proposed substitution over specified product.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Comply with applicable regulations and these specifications. Preserve the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by the Contracting Officer. Where violation of environmental procedures requirements will irreversibly damage the site, documentation of progress at 7 day intervals shall be required.

3.1.1 General Disturbance

Confine demolition and construction activities to work area limits indicated on the Drawings. Remove debris, rubbish, and other waste materials resulting from demolition and construction operations from site. Transport materials with appropriate vehicles and dispose of them off site to areas that are approved for disposal by governing authorities having jurisdiction. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways. Remove spillage and sweep, wash, or otherwise clean project site, streets, or highways. Burning is prohibited.

3.1.2 Water Resources

Comply with requirements of the NPDES and the applicable State Pollutant Discharge Elimination System (SPDES). Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Store and service construction equipment at areas designated for collection of oil wastes. Prevent ponding of stagnant water conducive to mosquito breeding habitat. Prevent run-off from site during demolition and

construction operations.

3.1.3 Land Resources

Prior to construction, identify land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the Contracting Officer.

3.1.3.1 Erodible Soils

Plan and conduct earthwork to minimize the duration of exposure of unprotected soils, except where the constructed feature obscures borrow areas, quarries, and waste material areas. Clear areas in reasonably sized increments only as needed to use the areas developed. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.

3.1.3.2 Erosion and Sedimentation Control Devices

Construct or install temporary and permanent erosion and sedimentation control features as required.

3.1.4 Air Resources

Comply with Indoor Air Quality (IAQ) Management Plan and as follows:

a. Prevent creation of dust, air pollution, and odors.

b. Sequence construction to avoid unnecessary disturbance to site.

c. Use water sprinkling, temporary enclosures, and other appropriate methods as needed to limit dust and dirt rising and scattering in air. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

d. Store volatile liquids, including fuels and solvents, in closed containers. Do not store with materials that have a high capacity to adsorb VOC emissions or in occupied spaces.

e. Properly maintain equipment to reduce gaseous pollutant emissions.

3.1.5 Fish and Wildlife Resources

Manage and control construction activities to minimize interference with and damage to fish and wildlife. Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat related to the project and critical to the survival of fish and wildlife, except as indicated or specified.

3.2 FIELD QUALITY CONTROL

Comply with requirements of agencies having jurisdiction and as specified herein. Provide field practices, shipping, and handling of samples in accordance with ASTM D 4840. Provide Field Quality Control Reports in accordance with approved Environmental Protection Plan.

-- End of Section --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS
11/14

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 B564 Standard Specification for 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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
E-mail: amca@amca.org
Internet: http://www.amca.org

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
Ph: 703-524-8800
Fax: 703-562-1942
E-mail: AHRI@AHRI_connect
Internet: http://www.ahrinet.org

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209
Ph: 703-358-2960
E-Mail: info@aluminum.org
Internet: http://www.aluminum.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800

Fax: 202-624-5806
E-Mail: info@aashto.org
Internet: http://www.aashto.org

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: http://www.concrete.org

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Ph: 513-742-2020 or 513-742-6163
Fax: 513-742-3355
E-mail: mail@acgih.org
Internet: http://www.acgih.org

AMERICAN HARDBOARD ASSOCIATION (AHA)
1210 West Northwest Highway
Palatine, IL 60067
Ph: 847-934-8800
Fax: 847-934-8803
E-mail: aha@hardboard.org
Internet: http://domensino.com/AHA/

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite 700
Chicago, IL 60601-1802
Ph: 312-670-2400
Fax: 312-670-5403
Bookstore: 800-644-2400
E-mail: aisc@ware-pak.com
Internet: http://www.aisc.org

AMERICAN IRON AND STEEL INSTITUTE (AISI)
25 Massachusetts Avenue, NW Suite 800
Washington, DC 20001
Ph: 202-452-7100
Internet: http://www.steel.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1899 L Street, NW,11th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: storemanager@ansi.org
Internet: http://www.ansi.org/

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191
Ph: 703-295-6300; 800-548-2723
E-mail: member@asce.org
Internet: http://www.asce.org

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
E-mail: ashrae@ashrae.org
Internet: http://www.ashrae.org

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)
1800 East Oakton Street
Des Plaines, IL 60018
Ph: 847-699-2929
Internet: http://www.asse.org

AMERICAN WATER WORKS ASSOCIATION (AWWA)
6666 West Quincy Avenue
Denver, CO 80235-3098
Ph: 303-794-7711
E-mail: distribution@awwa.org
Internet: http://www.awwa.org

AMERICAN WELDING SOCIETY (AWS)
13301 NW 47 Ave
Miami, FL 33054

Ph: 888-WELDING, 305-824-1177, 305-826-6192
Fax: 305-826-6195
E-mail: customer.service@awspubs.com
Internet: http://www.aws.org

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
P.O. Box 361784
Birmingham, AL 35236-1784
Ph: 205-733-4077
Fax: 205-733-4075
Internet: http://www.awpa.com

ASME INTERNATIONAL (ASME)
Two Park Avenue, M/S 10E
New York, NY 10016-5990
Ph: 800-843-2763
Fax: 973-882-1717
E-mail: customercare@asme.org
Internet: http://www.asme.org

ASPHALT INSTITUTE (AI)
2696 Research Park Drive
Lexington, KY 40511-8480
Ph: 859-288-4960
Fax: 859-288-4999
E-mail: info@asphaltinstitute.org
Internet: http://www.asphaltinstitute.org

ASSOCIATED AIR BALANCE COUNCIL (AABC)
1518 K Street, NW
Washington, DC 20005
Ph: 202-737-0202
Fax: 202-638-4833

E-mail: info@aabc.com
Internet: http://www.aabc.com/

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 North 18th Street
P.O. Box 2641
Birmingham, AL 35291-0992
Ph: 205-257-3839
E-Mail: aeicdir@bellsouth.net
Internet: http://www.aeic.org

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 877-909-2786
Internet: http://www.astm.org

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
355 Lexington Avenue, 15th Floor
New York, NY 10017
Ph: 212-297-2122
Fax: 212-370-9047
Internet: http://www.buildershardware.com

CALIFORNIA ENERGY COMMISSION (CEC)
Media and Public Communications Office
1516 Ninth Street, MS-29
Sacramento, CA 95814-5512
Ph: 916-654-5106
E-mail: appliances@energy.ca.gov
Internet: http://www.energy.ca.gov/

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
933 North Plum Grove Road
Schaumburg, IL 60173-4758
Ph: 847-517-1200
Fax: 847-517-1206
Internet: http://www.crsi.org/

FM GLOBAL (FM)
270 Central Avenue
P.O. Box 7500
Johnston, RI 02919-4923
Ph: 877-364-6726
Fax: 401-275-3029
E-mail: servicedesk.myrisk@fmglobal.com
Internet: http://www.fmglobal.com

GREEN SEAL (GS)
1001 Connecticut Avenue, NW
Suite 827
Washington, DC 20036-5525
Ph: 202-872-6400
Fax: 202-872-4324
Internet: http://www.greenseal.org

ILLUMINATING ENGINEERING SOCIETY (IES)
120 Wall Street, 17th Floor
New York, NY 10005-4001

Ph: 212-248-5000
Fax: 212-248-5018
E-mail: IES@IES.org
Internet: http://www.IES.org

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 and 501 Hoes Lane
Piscataway, NJ 08854-4141
Ph: 732-981-0060 or 800-701-4333
Fax: 732-562-9667
E-mail: onlinesupport@ieee.org
Internet: http://www.ieee.org

INTERNATIONAL CODE COUNCIL (ICC)
500 New Jersey Avenue, NW
6th Floor, Washington, DC 20001
Ph: 800-786-4452 or 888-422-7233
E-mail: order@iccsafe.org
Internet: www.iccsafe.org

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
3050 Old Centre Ave. Suite 102
Portage, MI 49024
Ph: 269-488-6382
Internet: http://www.netaworld.org

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
3, rue de Varembe
P.O. Box 131
CH-1211 Geneva 20, Switzerland
Ph: 41-22-919-02-11
Fax: 41-22-919-03-00
Internet: http://www.iec.ch

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
127 Park Street, NE
Vienna, VA 22180-4602
Ph: 703-281-6613
E-mail: info@mss-hq.com
Internet: http://mss-hq.org/Store/index.cfm

MASTER PAINTERS INSTITUTE (MPI)
2800 Ingleton Avenue
Burnaby, BC CANADA V5C 6G7
Ph: 1-888-674-8937
Fax: 1-888-211-8708
E-mail: info@paintinfo.com or techservices@mpi.net
Internet: http://www.mpi.net/

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)
1300 Sumner Avenue
Cleveland, OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105
E-mail: mbma@mbma.com
Internet: http://www.mbma.com

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)
16712 Elm Circle
Omaha, NE 68130
Ph: 800-747-6422
Fax: 402-330-9702
Internet: http://www.micainsulation.org

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Superintendent of Documents at
U.S. Government Printing Office
732 North Capitol Street, NW
Washington, DC 20401-0001
Ph: 202-783-3238
Fax: 202-512-1800
E-mail: ContactCenter@gpo.gov
Internet: http://www.nasa.gov or http://www.gpoaccess.gov

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 900
Arlington, VA 22209
Ph: 703-841-3200
Internet: http://www.nema.org/

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000
Fax: 617-770-0700
Internet: http://www.nfpa.org

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
100 Bureau Drive
Stop 1070
Gaithersburg, MD 20899-1070
Ph: 301-975-NIST (6478)
E-mail: inquiries@nist.gov
Internet: http://www.nist.gov

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)
Manager, Customer Service
900 Spring Street
Silver Spring, MD 20910
Ph: 240-485-1165
E-mail: jjenkins@nrmca.org (Jacques Jenkins)
Internet: http://www.nrmca.org

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)
10255 West Higgins Road, Suite 600
Rosemont, IL 60018-5607
Ph: 866-275-6722 (866-ASK-NRCA)
Fax: 847-299-1183

E-mail: info@nrca.net
Internet: http://www.nrca.net

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)
2, rue Andre Pascal
75775 Paris Cedex 16, France
Ph: + 33 1 45 24 82 00
Fax: 33 1 45 24 85 00
Internet: http://www.oecd.org
U.S. Contact Center
OECD Washington Center
2001 L Street, NW, Suite 650
Washington, DC 20036-4922
Ph: 202-785-6323
Fax: 202-785-0350
E-mail: washington.contact@oecd.org

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)
2000 Powell Street, Suite 600
Emeryville, CA 94608
Ph: 800-326-3228
E-mail: info@SCSglobal services.com
Internet: http://www.scsglobalservices.com/

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1219
Ph: 703-803-2980
Fax: 703-803-3732
Internet: http://www.smacna.org

SOCIETY FOR PROTECTIVE COATINGS (SSPC)
40 24th Street, 6th Floor
Pittsburgh, PA 15222
Ph: 412-281-2331
Fax: 412-281-9992
E-mail: info@sspc.org
Internet: http://www.sspc.org

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)
Publication Distribution Unit
1801 30th Street
Sacramento, CA 95816-8041
Ph: 916-227-8396
E-mail: michael_campos@dot.ca.gov
Internet: http://www.dot.ca.gov/hq/esc/techpubs/

STEEL DECK INSTITUTE (SDI)
P.O. Box 426
Glenshaw, PA 15116
Ph: 412.487.3325
Fax: 412.487.3326
E-mail: bob@sdi.org
Internet: http://www.sdi.org

STEEL DOOR INSTITUTE (SDI/DOOR)
30200 Detroit Road
Westlake, OH 44145

Ph: 440-899-0010
Fax: 440-892-1404
E-mail: info@steeldoor.org
Internet: http://www.steeldoor.org

STEEL JOIST INSTITUTE (SJI)
234 W. Cheves Street
Florence, SC 29501
Ph: 843-407-4091
Internet: http://www.steeljoist.org

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
1320 N. Courthouse Rd., Suite 200
Arlington, VA 22201
Ph: 703-907-7700
Fax: 703-907-7727
Internet: http://www.tiaonline.org

TURFGRASS PRODUCERS INTERNATIONAL (TPI)
2 East Main Street
East Dundee, IL 60118
Ph: 847-649-5555
Fax: 847-649-5678
E-mail: info@turfgrasssod.org
Internet: http://www.turfgrasssod.org

U.S. ARMY (DA)
U.S. Army Publishing Directorate
Ph: 703-614-3634
Internet: http://www.apd.army.mil

U.S. ARMY CORPS OF ENGINEERS (USACE)
CRD-C DOCUMENTS available on Internet:
http://www.wbdg.org/ccb/browse_cat.php?c=68
Order Other Documents from:
USACE Publications Depot
Attn: CEHEC-IM-PD
2803 52nd Avenue
Hyattsville, MD 20781-1102
Ph: 301-394-0081
Fax: 301-394-0084
E-mail: pubs-army@usace.army.mil
Internet: http://www.publications.usace.army.mil/
or
http://www.hnc.usace.army.mil/Missions/Engineering/TECHINFO.aspx

U.S. DEPARTMENT OF AGRICULTURE (USDA)
Order AMS Publications from:
AGRICULTURAL MARKETING SERVICE (AMS)
Seed Regulatory and Testing Branch
801 Summit Crossing Place, Suite C
Gastonia, NC 28054-2193
Ph: 704-810-8871
Fax: 704-852-4189
E-mail: seed.ams@usda.gov
Internet: http://www.ams.usda.gov/lsg/seed.htm
Order Other Publications from:
U.S. Department of Agriculture, Rural Utilities Program
USDA Rural Development, Room 4051-S

Mail Stop 1510
1400 Independence Avenue SW
Washington, DC 20250-1510
Phone: (202) 720-9540
TTY: (800) 877-8339 (Federal Relay Service)
Fax: (202) 720-1725
Internet: http://www.rurdev.usda.gov/utilities_lp.html

U.S. DEPARTMENT OF COMMERCE (DOC)
1401 Constitution Avenue, NW
Washington, DC 20230
Ph: 202-482-2000
Internet: http://www.commerce.gov/
Order Publications From:
National Technical Information Service (NTIS)
Alexandria, VA 22312
Ph: 703-605-6050 or 800-533-6847
E-mail: customerservice@ntis.gov
Internet: http://www.ntis.gov

U.S. DEPARTMENT OF DEFENSE (DOD)
Order DOD Documents from:
Room 3A750-The Pentagon
1400 Defense Pentagon
Washington, DC 20301-1400
Ph: 703-571-3343
FAX: 215-697-1462
E-mail: customerservice@ntis.gov
Internet: http://www.ntis.gov
Obtain Military Specifications, Standards and Related Publications from:
Acquisition Streamlining and Standardization Information System (ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)
Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: http://assist.daps.dla.mil/online/start/; account registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, CD 20005
Ph: 202-289-7800
Fax: 202-289-1092
Internet: http://www.wbdg.org/references/docs_refs.php

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20004
Ph: 202-272-0167
Internet: http://www2.epa.gov/libraries
--- Some EPA documents are available only from:
National Technical Information Service (NTIS)
5301 Shawnee Road

Alexandria, VA 22312
Ph: 703-605-6050 or 1-688-584-8332
Fax: 703-605-6900
E-mail: info@ntis.gov
Internet: http://www.ntis.gov

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)
Order for sale documents from:
Superintendent of Documents
U.S. Government Printing Office (GPO)
710 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: http://www.gpoaccess.gov
Order free documents from:
Federal Aviation Administration
Department of Transportation
800 Independence Avenue, SW
Washington, DC 20591
Ph: 1-866-835-5322
Internet: http://www.faa.gov

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)
445 12th Street SW
Washington, DC 20554
Ph: 888-225-5322
TTY: 888-835-5322
Fax: 866-418-0232
Internet: http://www.fcc.gov
Order Publications From:
Superintendent of Documents
U.S. Government Printing Office (GPO)
710 North Capitol Street, NW
Washington, DC 20401-0001
Ph: 202-512-1800
Fax: 866-418-0232
E-mail: gpoweb@gpo.gov
Internet: http://www.gpoaccess.gov/

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
General Services Administration
1275 First St. NE
Washington, DC 20417
Ph: 202-501-1231
Internet: http://www.gsaelibrary.gsa.gov/ElibMain/home.do
Obtain documents from:
Acquisition Streamlining and Standardization Information System (ASSIST)
Internet: https://assist.dla.mil/online/start/; account registration required

U. S. GREEN BUILDING COUNCIL (USGBC)
2101 L St NW, Suite 500
Washington, D.C. 20037
Ph: 800-795-1747
Internet: http://www.usgbc.org

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Fax: 301-837-0483
Internet: http://www.archives.gov
Order documents from:
Superintendent of Documents
U.S.Government Printing Office (GPO)
710 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: http://www.gpoaccess.gov

U.S. NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)
1322 Patterson Ave. SE, Suite 1000
Washington Navy Yard, DC 20374-5065
Ph: 202-685-9387
Internet: http://www.navfac.navy.mil

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road
Camas, WA 98607-8542
Ph: 877-854-3577
E-mail: CEC.us@us.ul.com
Internet: http://www.ul.com/
UL Directories available through IHS at http://www.ihs.com

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 45 00.00 25

QUALITY CONTROL
03/15
NAVFAC SE VERSION

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.

ASTM INTERNATIONAL (ASTM)

ASTM D6245	(2012) Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation
ASTM D6345	(2010) Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

ANSI/SMACNA 008	(2007) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 2011) Safety and Health Requirements Manual

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-01 Preconstruction Submittals

Construction Quality Control (QC) Plan; G

Submit an approved Construction QC Plan prior to start of construction.

Basis of Design and Design Intent

SD-07 Certificates

CA Resume

1.3 INFORMATION FOR THE CONTRACTING OFFICER

Prior to commencing work on construction, the Contractor can obtain a

single copy set of the current report forms from the Contracting Officer. The report forms will consist of the Contractor Production Report, Contractor Production Report (Continuation Sheet), Contractor Quality Control (CQC) Report, (CQC) Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Rework Items List, and Testing Plan and Log.

Deliver the following to the Contracting Officer during Construction:

a. CQC Report: Submit the report electronically b 10:00 AM the next working day after each day that work is performed and for every seven consectutive calendar days of no-work.

b. Contractor Production Report: Submit the report electronically by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.

c. Preparatory Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Preparatory Phase held.

d. Initial Phase Checklist: Submit the report electronically in the same manner as the CQC Report for each Initial Phase held.

e. Field Test Reports: Within two working days after the test is performed, submit the report as an electronic attachment to the CQC Report.

f. Monthly Summary Report of Tests: Submit the report as an electronic attachment to the CQC Report at the end of each month.

g. Testing Plan and Log: Submit the report as an electronic attachment to the CQC Report, at the end of each month. A copy of the final Testing Plan and Log shall be provided to the OMSI preparer for inclusion into the OMSI documentation.

h. Rework Items List: Submit lists containing new entries daily, in the same manner as the CQC Report.

i. CQC Meeting Minutes: Within two working days after the meeting is held, submit the report as an electronic attachment to the CQC Report.

j. 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. This QC program is a key element in meeting the objectives of NAVFAC Commissioning. The QC program consists of a QC Organization, QC Plan, QC Plan Meeting(s), a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, completion inspections, 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 must cover on-site and off-site work and be keyed to the work sequence. No construction work or testing may be performed unless the QC Manager is on the work site. The QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work

together effectively. Although the QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

1.4.1 Commissioning

Commissioning (Cx) is a systematic process of ensuring that all building systems meet the requirements and perform interactively according to the Contract. The QC Program is a key to this process by coordinating, verifying and documenting measures to achieve the following objectives:

a. Verify and document that the applicable equipment and systems are installed in accordance with the design intent as expressed through the Contract and according to the manufacturer's recommendations and industry accepted minimum standards.

b. Verify and document that equipment and systems receive complete operational checkout by the installing contractors.

c. Verify and document proper performance of equipment and systems.

d. Verify that Operation and Maintenance (O&M) documentation is complete.

e. Verify the Training Plan and training materials are accurate and provide correct instruction and documentation on the critical elements of the products, materials, and systems in the constructed facility. Verify that all identified Government operating personnel are trained.

1.4.2 Acceptance of the Construction Quality Control (QC) Plan

Acceptance 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, including removal of personnel, 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 the submitted qualifications. All QC organization personnel are subject to acceptance by the Contracting Officer. The Contracting Officer may require the removal of any individual for non-compliance with quality requirements specified in the Contract.

1.4.3 Preliminary Construction Work Authorized Prior to Acceptance

The only construction work that is authorized to proceed prior to the acceptance of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

1.4.4 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed changes in the QC Plan or changes to the QC organization personnel, a minimum of 10 work days prior to a proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The only duties and responsibilities of the QC Manager are to manage and implement the QC program on this Contract. The QC Manager is required to attend the partnering meetings, QC Plan Meetings, Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control , perform submittal review and approval, ensure testing is performed and provide 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 testing laboratory personnel and any other inspection and testing personnel required by this Contract. The QC Manager is the manager of all QC activities. The QC manager is responsible for notifying the Special InspectorSpecial Inspector of Record of activities which require their review.

1.5.1.2 Qualifications

An individual with a minimum of 5 years combined experience in the following positions: Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction contracts which included the major trades that are part of this Contract. The individual must have at least two years experience as a QC Manager. The individual must be familiar with the requirements of EM 385-1-1, and have experience in the areas of hazard identification, safety compliance, and sustainability.

1.5.2 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager must have completed the course entitled "Construction Quality Management (CQM) for Contractors." If the QC Manager does not have a current certification, they must obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of Engineers. Contact the Contracting Officer for information on the next scheduled class.

1.5.3 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 must be the same as for the QC Manager.

1.6 QUALITY CONTROL (QC) PLAN

1.6.1 Construction Quality Control (QC) Plan

1.6.1.1 Requirements

Provide, for acceptance by the Contracting Officer, a Construction QC Plan submitted in a three-ring binder that includes a table of contents, with

major sections identified with tabs, with pages numbered sequentially, and that documents the proposed methods and responsibilities for accomplishing quality control commissioning activities during the construction of the project:

a. QC ORGANIZATION: A chart showing the QC organizational structure.

b. NAMES AND QUALIFICATIONS: Names and qualifications, in resume format, for each person in the QC organization. Include the CQM for Contractors course certifications for the QC Manager and Alternate QC Manager as required by the paragraphs entitled "Construction Quality Management Training" and "Alternate QC Manager Duties and Qualifications".

c. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Duties, responsibilities, and authorities of each person in the QC organization.

d. OUTSIDE ORGANIZATIONS: 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.

e. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for implementing and managing the QC program as described in this Contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of control, and their authority to stop work which is not in compliance with the Contract. Letters of direction are to be issued by the QC Manager to all other QC Specialists outlining their duties, authorities, and responsibilities. Include copies of the letters in the QC Plan.

f. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing, approving, and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in Section 01 33 00 SUBMITTAL PROCEDURES.

g. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs entitled "Accreditation Requirements", as applicable.

h. TESTING PLAN AND LOG: 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. Use Government forms to log and track tests.

i. PROCEDURES TO COMPLETE REWORK ITEMS: Procedures to identify, record, track, and complete rework items. Use Government forms to record and track rework items.

j. DOCUMENTATION PROCEDURES: Use Government form.

k. LIST OF DEFINABLE FEATURES: A Definable Feature of Work (DFOW) is a task that is separate and distinct from other tasks and has control requirements and work crews unique to that task. A DFOW is identified by different trades or disciplines and is an item or activity on the

construction schedule. Include in the list of DFOWs, but not be limited to, all critical path activities on the NAS. Include all activities for which this specification requires QC Specialists or specialty inspection personnel. Provide separate DFOWs in the Network Analysis Schedule for each design development stage and submittal package.

l. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL: Identify procedures used to ensure the three phases of control to manage the quality on this project. For each DFOW, a Preparatory and Initial phase checklist will be filled out during the Preparatory and Initial phase meetings. Conduct the Preparatory and Initial Phases and meetings with a view towards obtaining quality construction by planning ahead and identifying potential problems for each DFOW.

m. PERSONNEL MATRIX: A personnel matrix showing for each section of the specification who will review and approve submittals, who will perform and document the three phases of control, and who will perform and document the testing.

n. PROCEDURES FOR COMPLETION INSPECTION: Procedures for identifying and documenting the completion inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.

o. TRAINING PROCEDURES AND TRAINING LOG: Not Applicable

p. ORGANIZATION AND PERSONNEL CERTIFICATIONS LOG: Procedures for coordinating, tracking and documenting all certifications on subcontractors, testing laboratories, suppliers, personnel, etc. QC Manager will ensure that certifications are current, appropriate for the work being performed, and will not lapse during any period of the contract that the work is being performed.

1.7 QC PLAN MEETINGS

Prior to submission of the QC Plan, the QC Manager will 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 and to agree on the Contractor's list of DFOWs.

1.8 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, and prior to the start of construction, the QC Manager will meet with the Contracting Officer to present the QC program required by this Contract. When a new QC Manager is appointed, the coordination and mutual understanding meeting shall be repeated.

1.8.1 Purpose

The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, design intent, Cx, environmental requirements and procedures, coordination of activities to be performed, and the coordination of the Contractor's management, production, and QC personnel. At the meeting, the Contractor will be required to explain in detail how three phases of control will be implemented for each DFOW, as well as how each DFOW will be affected by each management plan or requirement as listed below:

a. Waste Management Plan.

b. Procedures for noise and acoustics management.

c. Environmental Protection Plan.

d. Environmental regulatory requirements.

e. Cx Plan.

1.8.2 Coordination of Activities

Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different sections that are dependent on each other for proper installation and operation. Schedule construction operations with consideration for indoor air quality as specified in the IAQ Management Plan. Coordinate prefunctional tests and startup testing with Cx.

1.8.3 Attendees

As a minimum, the Contractor's personnel required to attend include an officer of the firm, the Project Manager, Project Superintendent, QC Manager, Alternate QC Manager, CA, Environmental Manager, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities shall have a principal of the firm at the meeting. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor and the Contracting Officer. Provide a copy of the signed minutes to all attendees.

1.9 QC MEETINGS

After the start of construction, conduct QC meetings once every two weeks by the QC Manager at the work site with the Project Superintendent, CA, and the foremen who are performing the work of the DFOWs. The QC Manager is to prepare the minutes of the meeting and provide a copy to the Contracting Officer within two working days after the meeting. The Contracting Officer may attend these meetings. As a minimum, accomplish the following at each meeting:

a. Review the minutes of the previous meeting.

b. Review the schedule and the status of work and rework.

c. Review the status of submittals.

d. Review the work to be accomplished in the next two weeks and documentation required.

e. Resolve QC and production problems (RFI, etc.).

f. Address items that may require revising the QC Plan.

g. Review Accident Prevention Plan (APP).

h. Review environmental requirements and procedures.

i. Review Waste Management Plan.

j. Review Environmental Management Plan.

k. Review the status of training completion.

l. Review Cx Plan and progress.

1.10 THREE PHASES OF CONTROL

Adequately cover both on-site and off-site work with the Three Phases of Control and include the following for each DFOW.

1.10.1 Preparatory Phase

Notify the Contracting Officer at least two work days in advance of each preparatory phase meeting. The meeting will be conducted by the QC Manager and attended by the Project Superintendent, the CA, and the foreman responsible for the DFOW. When the DFOW will be accomplished by a subcontractor, that subcontractor's foreman shall attend the preparatory phase meeting. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Preparatory Phase Checklist. Perform the following prior to beginning work on each DFOW:

a. Review each paragraph of the applicable specification sections.

b. Review the Contract drawings.

c. Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.

d. 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.

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

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

g. Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

h. Arrange for the return of shipping/packaging materials, such as wood pallets, where economically feasible.

i. 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.

j. Discuss specific controls used and construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW.

k. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Material

Safety Data Sheets (MSDS) are submitted.

l. Review the Cx Plan and ensure all preliminary work items have been completed and documented.

1.10.2 Initial Phase

Notify the Contracting Officer at least two work days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the initial phase with the Project Superintendent, and the foreman responsible for that DFOW. Observe the initial segment of the DFOW to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily CQC Report and in the Initial Phase Checklist. 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 DFOW:

a. Establish the quality of workmanship required.

b. Resolve conflicts.

c. Ensure that testing is performed by the approved laboratory.

d. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.

e. Review the Cx Plan and ensure all preparatory work items have been completed and documented.

1.10.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary, until the completion of each DFOW and document in the daily CQC 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 the approved laboratory.

d. Ensure that rework items are being corrected.

e. Assure manufacturers representatives have performed necessary inspections if required and perform safety inspections.

f. Review the Cx Plan and ensure all work items, testing, and documentation has been completed.

1.10.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW is resumed after substantial period of inactivity, or if other problems develop.

1.10.5 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.

1.11 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in Section 01 33 00 SUBMITTAL PROCEDURES.

1.12 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.

1.12.1 Accreditation Requirements

Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (E 329, C 1077, D 3666, D 3740, A 880, E 543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the Corporate Office.

1.12.2 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities include the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology at http://ts.nist.gov/ts/htdocs/210/214/214.htm , the American Association of State Highway and Transportation Officials (AASHTO) program at http://www.transportation.org/aashto/home.nsf/frontpage , International Accreditation Services, Inc. (IAS) at http://www.iasonline.org, U. S. Army Corps of Engineers Materials Testing Center (MTC)at http://www.wes.army.mil/SL/MTC/, the American Association for Laboratory Accreditation (A2LA) program at http://www.a2la.org/, the Washington Association of Building Officials (WABO) at http://www.wabo.org/ (Approval authority for WABO is limited to projects within Washington State), and the Washington Area Council of Engineering Laboratories (WACEL) at http://www.wacel.org/labaccred.html (Approval authority by WACEL is limited to projects within Facilities Engineering Command (FEC) Washington geographical area).

1.12.3 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.

1.12.4 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. If the item fails to conform, notify the Contracting Officer immediately.

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 must 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, per the paragraph entitled "INFORMATION FOR THE CONTRACTING OFFICER".

1.12.5 Test Reports and Monthly Summary Report of Tests

Furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the Contracting Officer. Attach a copy of the summary report to the last daily Contractor Quality Control Report of each month. Provide a copy of the signed test reports and certifications to the OMSI preparer for inclusion into the OMSI documentation.

1.13 QC CERTIFICATIONS

1.13.1 CQC Report Certification

Contain the following statement within the CQC Report: "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."

1.13.2 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, coordinated and attesting that the work for which payment is requested, including stored material, is in compliance with Contract requirements.

1.13.3 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." Provide a copy of this final QC Certification for completion to the OMSI preparer for inclusion into the OMSI documentation.

1.14 COMPLETION INSPECTIONS

1.14.1 Punch-Out Inspection

Near the completion of all work or any increment thereof, established by a completion time stated in the Contract Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QC Manager and the CA must conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings, specifications and Contract. Include in the punch list any remaining items on the "Rework Items List", which were not corrected prior to the Punch-Out Inspection. Include within the punch list the estimated date by which the deficiencies will be corrected. Provide a copy of the punch list to the Contracting Officer. The QC Manager, or staff, must make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the

facility is ready for the Government "Pre-Final Inspection".

1.14.2 Pre-Final Inspection

The Government and QCM will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" will be documented by the CQM as a result of this inspection. The QC Manager will ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the Client can be scheduled. Any items noted on the "Pre-Final" inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work,or any particular increment thereof, if the project is divided into increments by separate completion dates.

1.14.3 Final Acceptance Inspection

Notify the Contracting Officer at least 14 calendar days prior to the date a final acceptance inspection can be held. State within the notice that all items previously identified on the pre-final punch list will be corrected and acceptable, along with any other unfinished Contract work, by the date of the final acceptance inspection. The Contractor must be represented by the QC Manager, the Project Superintendent, the CA, and others deemed necessary. Attendees for the Government will include the Contracting Officer, other FEAD/ROICC personnel, and personnel representing the Client. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.15 DOCUMENTATION

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

1.15.1 Construction Documentation

Reports are required for each day that work is performed and must be attached to the Contractor Quality Control Report prepared for the same day. Maintain current and complete records of on-site and off-site QC program operations and activities. The forms identified under the paragraph "INFORMATION FOR THE CONTRACTING OFFICER" will be used. Reports are required for each day work is performed. Account for each calendar day throughout the life of the Contract. Every space on the forms must be filled in. Use N/A if nothing can be reported in one of the spaces. The Project Superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work must be identified by terminology consistent with the construction schedule. In the "remarks" sections of the reports, enter 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, quality control problem areas, deviations from the QC Plan, construction deficiencies encountered, meetings held. For each entry in the report(s), identify the Schedule Activity No. that is associated with the entered remark.

1.15.2 Quality Control Validation

Establish and maintain the following in a series of three ring binders. Binders shall be divided and tabbed as shown below. These binders must be readily available to the Contracting Officer during all business hours.

a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.

b. All milestone inspections, arranged by Activity Number.

c. An up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section.

d. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.

e. An up-to-date copy of the Rework Items List.

f. Maintain up-to-date copies of all punch lists issued by the QC staff to the Contractor and Sub-Contractors and all punch lists issued by the Government.

g. Commissioning documentation including Cx checklists, schedules, tests, and reports.

1.15.3 Reports from the QC Specialist(s)

Reports are required for each day that work is performed in their area of responsibility. QC Specialist reports shall include the same documentation requirements as the CQC Report for their area of responsibility. QC Specialist reports are to be prepared, signed and dated by the QC Specialists and shall be attached to the CQC Report prepared for the same day.

1.15.4 Testing Plan and Log

As tests are performed, the CA and the QC Manager will record on the "Testing Plan and Log" the date the test was performed and the date the test results were forwarded to the Contracting Officer. Attach a copy of the updated "Testing Plan and Log" to the last daily CQC Report of each month, per the paragraph "INFORMATION FOR THE CONTRACTING OFFICER". Provide a copy of the final "Testing Plan and Log" to the OMSI preparer for inclusion into the OMSI documentation.

1.15.5 Rework Items List

The QC Manager must 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, the date the item will be corrected by, 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 "Rework Items List" to the last daily CQC Report of each month. The Contractor is responsible for including those items identified by the Contracting Officer.

1.15.6 As-Built Drawings

The QC Manager is required to ensure the as-built drawings, required by

Section 01 78 00.00 25 CLOSEOUT SUBMITTALS are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. PC No., Modification No., Request for Information No., etc.). The QC Manager must initial each revision. Upon completion of work, the QC Manager will furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

1.16 NOTIFICATION ON NON-COMPLIANCE

The Contracting Officer will notify the Contractor of any detected non-compliance with the Contract. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time for excess costs or damages by the Contractor.

1.17 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

Submit an IAQ Management Plan within 15 days after Contract award and not less than 10 days before the preconstruction meeting. Revise and resubmit Plan as required by the Contracting Officer. Make copies of the final plan available to all workers on site. Include provisions in the Plan to meet the requirements specified below and to ensure safe, healthy air for construction workers and building occupants.

1.17.1 Requirements During Construction

Provide for evaluation of indoor Carbon Dioxide concentrations in accordance with ASTM D6245. Provide for evaluation of volatile organic compounds (VOCs) in indoor air in accordance with ASTM D6345. Use filters with a Minimum Efficiency Reporting Value (MERV) of 8 in permanently installed air handlers during construction.

1.17.1.1 Control Measures

Meet or exceed the requirements of ANSI/SMACNA 008, Chapter 3, to help minimize contamination of the Airfield Lighting Vault from construction activities. The five requirements of this manual which must be adhered to are described below:

a. HVAC protection: Isolate return side of HVAC system from surrounding environment to prevent construction dust and debris from entering the duct work and spaces.

b. Source control: Use low emitting paints and other finishes, sealants, adhesives, and other materials as specified. When available, cleaning products shall have a low VOC content and be non-toxic to minimize Vault contamination. Utilize cleaning techniques that minimize dust generation. Cycle equipment off when not needed. Prohibit idling motor vehicles where emissions could be drawn into Airfield Lighting Vault. Designate receiving/storage areas for incoming material that minimize IAQ impacts.

c. Pathway interruption: When pollutants are generated use strategies

such as 100 percent outside air ventilation or erection of physical barriers between work and non-work areas to prevent contamination.

d. Housekeeping: Clean frequently to remove construction dust and debris. Promptly clean up spills. Remove accumulated water and keep work areas dry to discourage the growth of mold and bacteria. Take extra measures when hazardous materials are involved.

e. Scheduling: Control the sequence of construction to minimize the absorption of VOCs by other vault materials.

1.17.1.2 Moisture Contamination

a. Remove accumulated water and keep work dry.

b. Use dehumidification to remove moist, humid air from a work area.

c. Do not use combustion heaters or generators inside the vault.

d. Protect porous materials from exposure to moisture.

e. Remove and replace items which remain damp for more than a few hours.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION

Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 50 00.00 25

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
12/14

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 FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2013) Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction site plan; G

1.3 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.4 HURRICANE CONDITION OF READINESS

Unless directed otherwise, comply with:

a. Condition FOUR (Sustained winds of 50 knots or greater expected within

72 hours): Normal daily jobsite cleanup and good housekeeping 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. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than 4 feet high. Remove all debris, trash, or objects that could become missile hazards. Contact Contracting Officer for Condition of Readiness (COR) updates and completion of required actions.

b. Condition THREE (Sustained winds of 50 knots or greater expected within 48 hours): Maintain "Condition FOUR" requirements and commence securing operations necessary for "Condition ONE" which cannot be completed within 18 hours. Cease all routine activities which might interfere with securing operations. Commence securing and stow all gear and portable equipment. Make preparations for securing buildings. Review requirements pertaining to "Condition TWO" and continue action as necessary to attain "Condition THREE" readiness. Contact Contracting Officer for weather and COR updates and completion of required actions.

c. Condition TWO (Sustained winds of 50 knots or greater expected within 24 hours): Curtail or cease routine activities until securing operation is complete. Reinforce or remove form work and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite. Expend every effort to clear all missile hazards and loose equipment from general base areas. Contact Contracting Officer for weather and Condition of Readiness (COR) updates and completion of required actions.

d. Condition ONE. (Sustained winds of 50 knots or greater expected within 12 hours): Secure the jobsite, and leave Government premises.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer.

2.1.2 Project and Safety Signs

The requirements for the signs, their content, and location are as specified in Section 01 58 00.00 25 PROJECT IDENTIFICATION. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Haul Roads

Construct access and haul roads necessary for proper prosecution of the work under this contract. Construct with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic are be avoided. Provide

necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, must be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads are subject to approval by the Contracting Officer. Lighting must be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations.

2.2.2 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.3 Fencing

Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people.

a. Enclose the project work area and Contractor lay-down area with a 8 ft high . Remove the fence upon completion and acceptance of the work. Intent is to block (screen) public view of the construction.

2.2.4 Temporary Wiring

Provide temporary wiring in accordance with NFPA 241 and NFPA 70. Include frequent inspection of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Contractor employees will park privately owned vehicles in an area designated by the Contracting Officer. Contractor employee parking must not interfere with existing and established parking requirements of the government installation.

3.2 TEMPORARY BULLETIN BOARD

Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer.

3.3 AVAILABILITY AND USE OF UTILITY SERVICES

3.3.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.3.2 Payment for Utility Services

a. The Government will make all reasonably required utilities available at no charge to the Contractor from existing outlets and supplies, as specified in the contract.

3.3.3 Temporary Connections

At the Contractors expense and in a manner satisfactory to the Contracting Officer, provide and maintain necessary temporary connectionsand distribution linesrequired. Notify the Contracting Officer, in writing, 5 working days before final electrical connection is desired so that a utilities contract can be established. The Government will make the final hot connection after inspection and approval of the Contractor's temporary wiring installation. The Contractor will not make the final electrical connection.

3.3.4 Sanitation

a. Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any municipal, district, or commercial sanitary sewer system. Any penalties and / or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

b. Provide temporary sewer and sanitation facilities that are self-contained units with both urinals and stool capabilities. Ventilate the units to control odors and fumes and empty and clean them at least once a week or more often if required by the Contracting Officer. The doors shall be self-closing. The exterior of the unit shall match the base standard color. Locate the facility behind the construction fence or out of the public view.

3.3.5 Telephone

Make arrangements for telephone facilities desired.

3.3.6 Obstruction Lighting of Cranes

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet 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.

3.3.7 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.4 TRAFFIC PROVISIONS

3.4.1 Maintenance of Traffic

a. Conduct operations in a manner that will not close any thoroughfare or

interfere in any way with traffic on railways or highways except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification dateMake all notifications and obtain any permits required for modification to traffic movements outside Station's jurisdiction.. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

c. Provide, erect, and maintain, at Contractor's expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

3.4.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.4.3 Rush Hour Restrictions

Do not interfere with the peak traffic flows preceding and during normal operations without notification to and approval by the Contracting Officer.

3.4.4 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.5 CONTRACTOR'S TEMPORARY FACILITIES

Contractor-owned or -leased trailers must be identified by Government assigned numbers. Size and location of the number will comply with the Contracting Officer direction. Apply the number to the trailer within 14 calendar days of notification, or sooner, if directed by the Government.

3.5.1 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety

devices or equipment and obtain approval from the Contracting Officer.

3.5.2 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

3.5.3 Storage Area

Construct a temporary 6 foot high chain link fence around trailers and materials. Include plastic strip inserts, colored brown, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store Trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

3.5.4 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor is responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

3.5.5 Appearance of Trailers

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on installation property.

b. Paint in accordance with facility standards and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

3.5.6 Maintenance of Storage Area

a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or

trimmed neatly.

b. Cut grass (or annual weeds) within the construction and storage sites to a maximum 4 inch height at least once a week during the growing season unless the grass area is not visible to the public. Trim the grass around fences at time of grass cutting. Maintain grass or weeds on stockpiled earth as descried above.

3.5.7 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The lighting cannot interfere with airplane and airfield operations. The Contractor will be responsible for the security of its own equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

3.5.8 Storage Size and Location

The site available for storage must be as indicated.

3.5.9 Weather Protection of Temporary Facilities and Stored Materials

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.

3.5.9.1 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 must 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.

3.6 GOVERNMENT FIELD OFFICE

3.6.1 Quality Control Manager Records and Field Office

Provide on the jobsite an office with approximately 100 square feet of useful floor area for the exclusive use of the QC Manager. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a 4 by 8 foot plan table, a standard size office desk and chair, computer station, and working communications facilities. Provide a door with a cylinder lock and windows with locking hardware. Make utility connections. Locate as directed. File quality control records in the office and make available at all times to the Government. After completion of the work, remove the entire structure from the site.

3.6.2 Trailer-Type Mobile Office

The Contractor may, at its option, furnish and maintain a trailer-type

mobile office acceptable to the Contracting Officer and providing as a minimum the facilities specified above. Securely anchor the trailer to the ground at all four corners to guard against movement during high winds.

3.7 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor must install a satisfactory means of communication, such as telephone or other suitable devices and made available for use by Government personnel.

3.8 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

3.9 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store any salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

3.10 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore areas used by the Contractor for the storage of equipment or material, or other use to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 57 16.00 25

TEMPORARY PEST CONTROL
12/14
NAVFAC SE VERSION

PART 1 GENERAL

1.1 SUMMARY

The work consists of minimizing environmental pollution and damage that may occur as the result of Pest Control. Protect the environmental resources within the project boundaries, and those affected outside the limits of permanent work, during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. Any delays resulting from failure to comply with environmental laws and regulations will be the Contractor's responsibility.

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.

U.S. ARMY (DA)

DA AR 200-1	(2007) Environmental Protection and Enhancement

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

40 CFR 152 - 186	Pesticide Programs

1.3 DEFINITIONS

1.3.1 Installation Pest Management Coordinator

Installation Pest Management Coordinator (IPMC) is the individual officially designated by the Installation Commander to oversee the Installation Pest Management Program and the Installation Pest Management Plan.

1.3.2 Project Pesticide Coordinator

The Project Pesticide Coordinator (PPC) is an individual that resides at a Civil Works Project office and that is responsible for oversight of pesticide application on Project grounds.

1.3.3 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.3.4 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi,

bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pesticide Treatment Plan G

1.5 QUALITY CONTROL

1.5.1 Qualifications

For the application of pesticides, use the services of a subcontractor whose principal business is pest control. Provide a subcontractor licensed and certified in the state where the work is to be performed.

1.5.2 Pesticide Treatment Plan

Include and update a pesticide treatment plan, as information becomes available. Include in the plan: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Installation Project Office specific requirements are the Contractor's responsibility in conformance with DA AR 200-1 Chapter 5, Pest Management, Section 5-4 "Program requirements" for data required to be reported to the Installation.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Pesticide Delivery and Storage

Deliver pesticides to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Store pesticides according to manufacturer's instructions and under lock and key when unattended.

1.6.2 Pesticide Handling Requirements

Formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Furnish Material Safety Data Sheets (MSDS) for all pesticide products.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 INTEGRATED PEST MANAGEMENT

In order to minimize impacts to existing fauna and flora, the Contractor through the Contracting Officer, shall coordinate with the Installation Pest Management Coordinator (IPMC) Project Pesticide Coordinator (PPC)at the earliest possible time prior to pesticide application. Discuss integrated pest management strategies with the IPMC PPC and receive concurrence from the IPMC PPC through the COR prior to the application of any pesticide associated with these specifications. Installation Project Office Pest Management personnel will be given the opportunity to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under 40 CFR 152 - 186.

3.2 APPLICATION

Apply pesticides using a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. The Contracting Officer will designate locations for water used in formulating. Do not allow the equipment to overflow. Inspect all equipment for leaks, clogging, wear, or damage and repaired prior to application of pesticide.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 57 19.00 25

TEMPORARY ENVIRONMENTAL CONTROLS
03/15
NAVFAC SE VERSION

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)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 833-R-060-04	(2007) Developing Your Storm Water Pollution Prevention Plan, a Guide for Construction Sites

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

29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
40 CFR 112	Oil Pollution Prevention
40 CFR 112.7	General Requirements for Spill Prevention, Control, and Countermeasure Plans
40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)
40 CFR 241	Guidelines for Disposal of Solid Waste
40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR 258	Subtitle D Landfill Requirements
40 CFR 260	Hazardous Waste Management System: General
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 271	Requirements for Authorization of State Hazardous Waste Programs
40 CFR 272	Approved State Hazardous Waste Management Programs
40 CFR 273	Standards For Universal Waste Management
40 CFR 279	Standards for the Management of Used Oil
40 CFR 280	Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 355	Emergency Planning and Notification
40 CFR 372-SUBPART D	Specific Toxic Chemical Listings
40 CFR 60	Standards of Performance for New Stationary Sources
40 CFR 63	National Emission Standards for Hazardous Air Pollutants for Source Categories
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 171	General Information, Regulations, and Definitions
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 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.2 Solid Waste

Garbage, refuse, debris, sludge, or other discharged material, including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations. Types of solid waste typically generated at construction sites may include:

a. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.

b. Surplus soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.

c. Debris: Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 2.5 inch particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders), broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may be reinforced with or contain ferrous wire, rods, accessories and weldments. A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

d. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.

e. Scrap metal: Scrap and excess ferrous and non-ferrous metals such as reinforcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

f. Paint cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.

g. Recyclables: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans may not be included as recyclable if sold to a scrap metal company.

h. Hazardous Waste: By definition, to be a hazardous waste a material must first meet the definition of a solid waste. Hazardous waste and hazardous debris are special cases of solid waste. They have additional regulatory controls and must be handled separately. They are thus defined separately in this document.

   Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

1.2.3 Hazardous Debris

As defined in Solid Waste paragraph, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

1.2.4 Chemical Wastes

This includes salts, acids, alkalizes, herbicides, pesticides, and organic chemicals.

1.2.5 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2.6 Hazardous Waste

Any discarded material, liquid, solid, or gas, which meets the definition of hazardous material or is designated hazardous waste by the Environmental Protection Agency or State Hazardous Control Authority as defined in 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 271, 40 CFR 272, 40 CFR 273, 40 CFR 279, and 40 CFR 280.

1.2.7 Hazardous Materials

Hazardous materials as defined in 49 CFR 171 and listed in 49 CFR 172.

Hazardous material is any material that:

a. Is regulated as a hazardous material per 49 CFR 173, or

b. Requires a Material Safety Data Sheet (MSDS) per 29 CFR 1910.120, or

c. During end use, treatment, handling, packaging, storage, transpiration, or disposal meets or has components that meet or have potential to meet the definition of a hazardous waste as defined by 40 CFR 261 Subparts A, B, C, or D.

Designation of a material by this definition, when separately regulated or controlled by other instructions or directives, does not eliminate the need for adherence to that hazard-specific guidance which takes precedence over this instruction for "control" purposes. Such material include ammunition, weapons, explosive actuated devices, propellants, pyrotechnics, chemical

and biological warfare materials, medical and pharmaceutical supplies, medical waste and infectious materials, bulk fuels, radioactive materials, and other materials such as asbestos, mercury, and polychlorinated biphenyls (PCBs). Nonetheless, the exposure may occur incident to manufacture, storage, use and demilitarization of these items.

1.2.8 Waste Hazardous Material (WHM)

Any waste material which because of its quantity, concentration, or physical, chemical, or infectious characteristics may pose a substantial hazard to human health or the environment and which has been so designated. Used oil not containing any hazardous waste, as defined above, falls under this definition.

1.2.9 Oily Waste

Those materials which are, or were, mixed with used oil and have become separated from that used oil. Oily wastes also means materials, including wastewaters, centrifuge solids, filter residues or sludges, bottom sediments, tank bottoms, and sorbents which have come into contact with and have been contaminated by, used oil and may be appropriately tested and discarded in a manner which is in compliance with other State and local requirements.

This definition includes materials such as oily rags, "kitty litter" sorbent clay and organic sorbent material. These materials may be land filled provided that:

a. It is not prohibited in other State regulations or local ordinances

b. The amount generated is "de minimus" (a small amount)

c. It is the result of minor leaks or spills resulting from normal process operations

d. All free-flowing oil has been removed to the practical extent possible

Large quantities of this material, generated as a result of a major spill or in lieu of proper maintenance of the processing equipment, are a solid waste. As a solid waste, a hazardous waste determination must be performed prior to disposal. As this can be an expensive process, it is recommended that this type of waste be minimized through good housekeeping practices and employee education.

1.2.10 Regulated Waste

Those solid wastes that have specific additional Federal, state, or local controls for handling, storage, or disposal.

1.2.11 Class I and II Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11)
chlorofluorocarbon-12 (CFC-12)

chlorofluorocarbon-13 (CFC-13)
chlorofluorocarbon-111 (CFC-111)
chlorofluorocarbon-112 (CFC-112)
chlorofluorocarbon-113 (CFC-113)
chlorofluorocarbon-114 (CFC-114)
chlorofluorocarbon-115 (CFC-115)
chlorofluorocarbon-211 (CFC-211)
chlorofluorocarbon-212 (CFC-212)
chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-217 (CFC-217)
chlorofluorocarbon-500 (CFC-500)
chlorofluorocarbon-502 (CFC-502)
chlorofluorocarbon-503 (CFC-503)
halon-1211
halon-1301
halon-2402
carbon tetrachloride
methyl bromide
methyl chloroform

Class II ODS is defined in Section 602(s) of The Clean Air Act and includes the following chemicals:

hydrochlorofluorocarbon-21 (HCFC-21)
hydrochlorofluorocarbon-22 (HCFC-22)
hydrochlorofluorocarbon-31 (HCFC-31)

hydrochlorofluorocarbon-121 (HCFC-121)
hydrochlorofluorocarbon-122 (HCFC-122)
hydrochlorofluorocarbon-123 (HCFC-123)
hydrochlorofluorocarbon-124 (HCFC-124)
hydrochlorofluorocarbon-131 (HCFC-131)
hydrochlorofluorocarbon-132 (HCFC-132)
hydrochlorofluorocarbon-133 (HCFC-133)
hydrochlorofluorocarbon-141 (HCFC-141)
hydrochlorofluorocarbon-142 (HCFC-142)
hydrochlorofluorocarbon-221 (HCFC-221)
hydrochlorofluorocarbon-222 (HCFC-222)
hydrochlorofluorocarbon-223 (HCFC-223)
hydrochlorofluorocarbon-224 (HCFC-224)
hydrochlorofluorocarbon-225 (HCFC-225)
hydrochlorofluorocarbon-226 (HCFC-226)
hydrochlorofluorocarbon-231 (HCFC-231)
hydrochlorofluorocarbon-232 (HCFC-232)
hydrochlorofluorocarbon-233 (HCFC-233)
hydrochlorofluorocarbon-234 (HCFC-234)
hydrochlorofluorocarbon-235 (HCFC-235)
hydrochlorofluorocarbon-251 (HCFC-251)
hydrochlorofluorocarbon-252 (HCFC-252)
hydrochlorofluorocarbon-253 (HCFC-253)
hydrochlorofluorocarbon-261 (HCFC-261)
hydrochlorofluorocarbon-262 (HCFC-262)
hydrochlorofluorocarbon-271 (HCFC-271)

1.2.12 Universal Waste

The universal waste regulations streamline collection requirements for

certain hazardous wastes in the following categories: batteries, pesticides, mercury-containing equipment (e.g., thermostats) and lamps (e.g., fluorescent bulbs). The rule is designed to reduce hazardous waste in the municipal solid waste (MSW) stream by making it easier for universal waste handlers to collect these items and send them for recycling or proper disposal. These regulations can be found at 40 CFR 273. Also include any other hazardous wastes that have been designated as universal wastes in individual states (e.g. Texas - paint related waste; Florida - pharmaceutical waste).

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preconstruction Survey; G

Solid Waste Management Plan and Permit; G

Regulatory Notifications; G

Environmental Protection Plan; G

Storm Water Pollution Prevention Plan; G

Storm Water Notice of Intent (for NPDES coverage under the general permit for construction activities); G

Dirt and Dust Control Plan

Contractor Hazardous Material Inventory Log; G

SD-06 Test Reports

Laboratory Analysis

Disposal Requirements

Erosion and Sediment Control Inspection Reports

Storm Water Inspection Reports for General Permit

Solid Waste Management Report; G

SD-07 Certificates

Contractor 40 CFR employee training records; G

ECATTS certificate of completion

SD-11 Closeout Submittals

Some of the records listed below are also required as part of other submittals. For the "Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the

completion of the project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

Storm Water Pollution Prevention Plan compliance notebook; G

Waste Determination Documentation

Disposal Documentation for Hazardous and Regulated Waste

Contractor 40 CFR Employee Training Records

Solid Waste Management Permit

Solid Waste Management Report

Contractor Hazardous Material Inventory Log; G

Hazardous Waste/Debris Management

Regulatory Notifications

1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. 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 water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

The Contractor may be required to promptly conduct tests and procedures for the purpose of assessing whether construction operations are in compliance with Applicable Environmental Laws. Analytical work shall be done by qualified laboratories; and where required by law, the laboratories shall be certified.

1.4.1 Environmental Compliance Assessment Training and Tracking System (ECATTS)

The QC Manager is responsible for environmental compliance on projects unless an Environmental Manager is named. The QC Manager (and alternative QC Manager) or Environmental Manager must complete ECATTS training prior to starting respective portions of on-site work under this contract. If personnel changes occur for any of these positions after starting work, replacement personnel must complete ECATTS training within 14 days of assignment to the project

Submit an ECATTS certificate of completion for personnel who have completed the required "Environmental Compliance Assessment Training and Tracking System (ECATTS)" training. This training is web-based and can be accessed from any computer with Internet access using the following instructions.

Register for NAVFAC Environmental Compliance Training and Tracking System, by logging on to http://navfac.ecatts.com/. Obtain the password for registration from the Contracting Officer.

This training has been structured to allow contractor personnel to receive credit under this contract and also to carry forward credit to future contracts. Contractors shall ensure that the QC Manager (and alternate QC Manager) or Environmental Manager review their training plans for new modules or updated training requirements prior to beginning work. Some training modules are tailored for specific State regulatory requirements; therefore, Contractors working in multiple states will be requires to re-take modules tailored to the state where the contract work is being performed.

ECATTS is available for use by all contractor and subcontractor personnel associated with this project. These other personnel are encouraged (but not required) to take the training and may do so at their discretion.

1.4.2 Conformance with the Environmental Management System

Perform work under this contract consistent with the policy and objectives identified in the installation's Environmental Management System (EMS). Perform work in a manner that conforms to objectives and targets, environmental programs and operational controls identified by the EMS. Provide monitoring and measurement information as necessary to address environmental performance relative to environmental, energy, and transportation management goals. In the event an EMS nonconformance or environmental noncompliance associated with the contracted services, tasks, or actions occurs, take corrective and/or preventative actions. In addition, ensure that employees are aware of their roles and responsibilities under the EMS and how these EMS roles and responsibilities affect work performed under the contract.

Ensure that employees receive applicable environmental and occupational health and safety training, and keep up to date on regulatory required specific training for the type of work to be conducted onsite. All on-site Contractor personnel, and their subcontractor personnel, performing tasks that have the potential to cause a significant environmental impact shall be competent on the basis of appropriate education, training or experience. Upon contract award, the Contracting Officer's Representative will notify the installation's EMS coordinator to arrange EMS training. Refer to Section 01 57 19.01 25, SUPPLEMENTAL TEMPORARY ENVIRONMENTAL CONTROLS for additional site specific EMS requirements related to construction. The installation's EMS coordinator will identify training needs associated with environmental aspects and the EMS, and arrange training or take other action to meet these needs. Provide training documentation to the Contracting Officer. The EMS coordinator must retain associated records.

1.5 QUALITY ASSURANCE

1.5.1 Preconstruction Survey

Perform a Preconstruction Survey of the project site with the Contracting Officer, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.

1.5.2 Regulatory Notifications

The Contractor is responsible for all regulatory notification requirements in accordance with Federal, State and local regulations. In cases where the Navy must also provide public notification (such as stormwater permitting), coordinate with the Contracting Officer. Submit copies of all

regulatory notifications to the Contracting Officer prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.5.3 Environmental Brief

Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the activity; types and quantities of wastes/wastewater that may be generated during the contract. Discuss the results of the Preconstruction Survey at this time.

Prior to initiating any work on site, meet with the Contracting Officer and activity environmental staff to discuss the proposed Environmental Protection Plan. Develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, required permits, permit requirements, and other measures to be taken.

1.5.4 Environmental Manager

Appoint in writing an Environmental Manager for the project site. The Environmental Manager will be directly responsible for coordinating contractor compliance with Federal, State, local, and station requirements. The Environmental Manager will ensure compliance with Hazardous Waste Program requirements (including hazardous waste handling, storage, manifesting, and disposal); implement the Environmental Protection Plan; ensure that all environmental permits are obtained, maintained, and closed out; ensure compliance with Storm Water Program Management requirements; ensure compliance with Hazardous Materials (storage, handling, and reporting) requirements; and coordinate any remediation of regulated substances (lead, asbestos, PCB transformers). This can be a collateral position; however the person in this position must be trained to adequately accomplish the following duties: ensure waste segregation and storage compatibility requirements are met; inspect and manage Satellite Accumulation areas; ensure only authorized personnel add wastes to containers; ensure all Contractor personnel are trained in 40 CFR requirements in accordance with their position requirements; coordinate removal of waste containers; and maintain the Environmental Records binder and required documentation, including environmental permits compliance and close-out.

1.5.5 Contractor 40 CFR Employee Training Records

Prepare and maintain employee training records throughout the term of the contract meeting applicable 40 CFR requirements. Ensure every employee completes a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures compliance with Federal, State and local regulatory requirements for RCRA Large Quantity Generator. Provide a Position Description for each employee, by subcontractor, based on the Davis-Bacon Wage Rate designation or other equivalent method, evaluating the employee's association with hazardous and regulated wastes. This Position Description will include training requirements as defined in 40 CFR 265 for a Large Quantity Generator facility. Submit these training records to the Contracting Officer at the conclusion of the project, unless otherwise directed.

1.6 ENVIRONMENTAL PROTECTION PLAN (EPP)

Prior to initiating any work on site, meet with the Contracting Officer to discuss the proposed Environmental Protection Plan and develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, and other measures to be taken. The Environmental Protection Plan must incorporate construction related objectives and targets from the installation's Environmental Management System. Submit the Environmental Protection Plan in the following format and include the elements specified below.

a. Description of the Environmental Protection Plan

(1) General overview and purpose

(a) A brief description of each specific plan required by environmental permit or elsewhere in this contract.

(b) The duties and level of authority assigned to the person(s) on the job site that oversee environmental compliance.

(c) A copy of any standard or project specific operating procedures that will be used to effectively manage and protect the environment on the project site.

(d) Communication and training procedures that will be used to convey environmental management requirements to contractor employees and subcontractors.

(e) Emergency contact information contact information (office phone number, cell phone number, and e-mail address).

(f) Copy of site plan showing where any fuels, hazardous substances, solvents, or lubricants will be stored.

(g) Copy of spill plan to address leaks or spills of fuels, hazardous substances, solvents, or lubricants.

(2) General site information

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

b. Management of Natural Resources

(1) Land resources

(2) Tree protection

(3) Replacement of damaged landscape features

(4) Temporary construction

(5) Stream crossings

(6) Fish and wildlife resources

(7) Wetland areas

c. Protection of Historical and Archaeological Resources

(1) Objectives

(2) Methods

d. Storm Water Management and Control

(1) Ground cover

(2) Erodible soils

(3) Temporary measures

(a) Mechanical retardation and control of runoff

(b) Vegetation and mulch

(4) Effective selection, implementation and maintenance of Best Management Practices (BMPs).

e. Protection of the Environment from Waste Derived from Contractor Operations

(1) Control and disposal of solid and sanitary waste. If Section 01 74 19.00 25 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT is included in the contract, submit the plan required by that section as part of the Environmental Protection Plan.

(2) Control and disposal of hazardous waste (Hazardous Waste Management Section)

This item will consist of the management procedures for all hazardous waste to be generated. The elements of those procedures will coincide with the Activity Hazardous Waste Management Plan. A copy of the Activity Hazardous Waste Management Plan will be provided by the Contracting Officer. As a minimum, include the following:

(a) Procedures to be employed to ensure a written waste determination is made for appropriate wastes which are to be generated;

(b) Sampling/analysis plan;

(c) Methods of hazardous waste accumulation/storage (i.e., in tanks and/or containers);

(d) Management procedures for storage, labeling, transportation, and disposal of waste (treatment of waste is not allowed unless specifically noted);

(e) Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with Land Disposal

Restrictions (40 CFR 268);

(f) Management procedures for recyclable hazardous materials such as lead-acid batteries, used oil, and the like;

(g) Used oil management procedures in accordance with 40 CFR 279;

(h) Pollution prevention\hazardous waste minimization procedures;

(i) Plans for the disposal of hazardous waste by permitted facilities;

(j) Procedures to be employed to ensure all required employee training records are maintained.

f. Prevention of Releases to the Environment

(1) Procedures to prevent releases to the environment

(2) Notifications in the event of a release to the environment

g. Regulatory Notification and Permits

List what notifications and permit applications must be made. Some permits require up to 90 days to obtain. Demonstrate that those permits have been obtained or applied for by including copies of all applicable, environmental permits. The Plan will not be approved until all permits have been obtained.

h. Clean Air Act Compliance

(1) Identify air pollution generating equipment or processes that may require federal, state, or local permits under the clean air act.

(2) Identify portable and stationary internal combustion engines (ICE's) that will be supplied, utilized or serviced. Address compliance with 40 CFR 60 Subpart IIII, 40 CFR 63 Subpart ZZZZ, and local regulations as applicable. At minimum, include the make, model, serial number, manufacture date, size (engine bhp), and EPA emission certification status of each engine.

(3) Identify management practices to ensure that HVAC work involving refrigerants complies with 40 CFR 82 requirements.

(4) Identify planned air pollution generating processes and management control measures (including but not limited to spray painting, abrasive blasting, demolition, material handling, fugitive dust, and fugitive emissions)

1.6.1 Environmental Protection Plan Review

Within thirty days after the Contract award date, submit the proposed Environmental Protection Plan for review and approval. Commencement of work will not begin until the environmental protection plan has been approved.

1.6.2 Licenses and Permits

Obtain licenses and permits pursuant to the "Permits and Responsibilities"

FAR Clause 52.236-7.

No permits will be obtained by the Contracting Officer.

Where required by the State regulatory authority, the inspections and certifications will be provided through the services of a Professional Engineer (PE), registered in the State where the work is being performed. As a part of the quality control plan, which is required by Section 01 45 00.00 25 QUALITY CONTROL, provide a sub item containing the name, appropriate professional registration or license number, address, and telephone number of the professionals or other qualified persons who will be performing the inspections and certifications for each permit.

PART 2 PRODUCTS

Not Used

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. If the work is near streams, lakes, or other waterways, conform to the national permitting requirements of the Clean Water Act.

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.

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the Contracting Officer's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Contracting Officer. Where such use of attached ropes, cables, or guys is authorized, the Contractor will be responsible for any resultant damage.

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. 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 replacement.

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. Obtain Contracting Officer's approval prior to installation. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition unless otherwise required by the Contracting Officer.

3.1.1 Erosion and Sediment Control Measures

3.1.1.1 Burnoff

Burnoff of the ground cover is not permitted.

3.1.1.2 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified. Immediately protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

3.1.1.3 Temporary Protection of Erodible Soils

Use the following methods to prevent erosion and control sedimentation:

a. Mechanical Retardation and Control of Runoff

Mechanically retard and control the rate of runoff from the constructionsite. This includes construction of diversion ditches, benches, berms, and use of silt fences and straw bales to retard and divert runoff to protected drainage courses.

b. Vegetation and Mulch

(1) 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.

(2) Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish or reestablish a suitable stand of grass. 32 92 19 SEEDING

3.1.2 Erosion and Sediment Control Inspection Reports

Submit "Erosion and Sediment Control Inspection Reports" (E&S) (form provided at the pre-construction conference) and Storm Water Inspection Reports for General Permit to the Contracting Officer once every 7 calendar days and within 24 hours of a storm event that produces 0.5 inch or more of rain.

Note erosion control inspection reports may be compiled as part of a stormwater pollution prevention plan inspection reports if applicable.

3.1.2.1 Storm Water Notice of Intent for Construction Activities and Storm Water Pollution Prevention Plan

Submit a Storm Water Notice of Intent (for NPDES coverage under the general permit for construction activities) and a Storm Water Pollution Prevention Plan (SWPPP) for the project to the Contracting Officer prior and gain approval prior to the commencement of work. The SWPPP must meet the requirements of the EPA or State general permit for storm water discharges

from construction sites. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate Federal or State agency for approval, a minimum of 45 calendar days prior to the start of any land disturbing activities. Maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, reflecting current site conditions.

Coverage under this permit requires the contractor prepare a Storm Water Pollution Prevention Plan (SWPPP), prepare and submit a Registration Statement as a co-permittee with the Construction Officer, and provide the permit fee to the responsible state agency before any land disturbing activities begin. File for permit coverage on behalf of both the Construction Officer and themselves, and file a Notice of Termination once construction is complete and the site is stabilized with a final sustainable cover.

Under the terms and conditions of the permit, the Contractor may be required to install, inspect, maintain best management practices (BMPs), and submit stormwater BMP inspection reports and stormwater pollution prevention plan inspection reports. Ensure construction operations and management are constantly in compliance with the terms and conditions of the general permit for storm water discharges from construction activities.

a. The SWPPP shall:

(1) Identify potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the site.

(2) Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge from the site.

(3) Ensure compliance with terms of the EPA or State general permit for storm water discharge.

(4) Select applicable best management practices from EPA 833-R-060-04.

(5) Include a completed copy of the Registration Statement, BMP Inspection Report Template and Notice of Termination except for the effective date.

(6) Storm Water Pollution Prevention Measures and Notice of Intent 40 CFR 122.26, EPA 833-R-060-04. Provide a "Storm Water Pollution Prevention Plan" (SWPPP) for the project. The SWPPP will meet the requirements of the EPA or State general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate Federal or State agency for approval, a minimum of 14 calendar days prior to the start of construction. A copy of the approved SWPPP will be kept at the construction on-site office, and continually updated as regulations require reflecting current site conditions.

3.1.2.2 Storm Water Pollution Prevention Plan Compliance Notebook

Create and maintain a three ring binder of documents that demonstrate compliance with the Stormwater Construction Activity permit. The binder

shall include a copy of the permit Registration Statement, proof of permit fee payment, SWPPP and SWPPP update amendments, inspection reports, copies of correspondence with the Texas Commission on Environmental Quality (TCEQ) and a copy of the permit Notice of Termination. At the completion of the project the notebook shall become the property of the Government. Provide the compliance notebook to Contracting Officer. Provide an advance copy of the Registration Statement to the Contracting Officer immediately after the form is presented to the permitting agency.

3.1.3 Stormwater Drainage and Construction Dewatering

There will be no discharge of excavation ground water to the sanitary sewer, storm drains, or to the river without prior specific authorization of the Environmental Division in writing. Discharge of hazardous substances will not be permitted under any circumstances.

Construction site runoff will be prevented from entering any storm drain or the river directly by the use of waddles or other method suitable to the Environmental Division. Contractor will provide erosion protection of the surrounding soils.

Construction Dewatering shall not be discharged to the sanitary sewer. If the construction dewatering is noted or suspected of being contaminated, it may only be released to the storm drain system if the discharge is specifically permitted. Authorization for any contaminated groundwater release shall be obtained in advance from the base Environmental Officer. Discharge of hazardous substances will not be permitted under any circumstances.

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. Upon discovery, notify the Contracting Officer. 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 SOLID WASTE MANAGEMENT PLAN and PERMIT

Provide to the contracting officer written notification of the quantity of solid waste/debris that is anticipated to be generated by construction. Include in the report the locations where various types of waste will be disposed or recycled. Include letters of acceptance or as applicable, submit one copy of a State and local Solid Waste Management Permit or license showing such agency's approval of the disposal plan before transporting wastes off Government property.

3.3.1 Solid Waste Management Report

Monthly, submit a solid waste disposal report to the Contracting Officer. For each waste, the report will state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste.

Include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste which is signed by an officer of the

Contractor firm authorized to legally obligate or bind the firm. The sales documentation or Contractor certification will include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained by the Contractor for his own use, the Contractor will submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received will not be reported to the Contracting Officer unless required by other provisions or specifications of this Contract or public law.

3.3.2 Control and Management of Solid Wastes

Pick up 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. Recycling is encouraged and can be coordinated with the Contracting Officer and the activity recycling coordinator. Remove all solid waste (including non-hazardous debris) from Government property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent local, State, and Federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

Manage spent hazardous material used in construction, including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags, as per environmental law.

3.3.2.1 Disposal Documentation for Hazardous and Regulated Waste

Manifest, pack, ship and dispose of hazardous or toxic waste and universal waste that is generated as a result of construction in accordance with the generating facilities generator status under the Recourse Conservation and Recovery Act. Contact the Contracting Officer for the facility RCRA identification number that is to be used on each manifest.

Submit a copy of the applicable EPA and or State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities. Hazardous or toxic waste manifest must be reviewed, signed, and approved by the Navy before the Contractor may ship waste. To obtain specific disposal instructions coordinate with the Installation Environmental office.

3.3.2.2 Dumpsters

Equip dumpsters with a secure cover and paint the standard base color. Keep cover closed at all times, except when being loaded with trash and debris. Locate dumpsters behind the construction fence or out of the public view. Empty site dumpsters at least once a week. or as needed to keep the site free of debris and trash. If necessary, provide 55 gallon trash containers painted the darker base color to collect debris in the construction site area. Keep 55 gallon trash containers closed at all times, except when being loaded with trash or debris. Locate the trash containers behind the construction fence or out of the public view. Empty trash containers at least once a day. For large demolitions, large dumpsters without lids are acceptable but should not have debris higher than the sides before emptying. Keep large dumpsters closed at all times, except when being loaded with trash or debris.

3.4 WASTE DETERMINATION DOCUMENTATION

Complete a Waste Determination form (provided at the pre-construction conference) for all contractor derived wastes to be generated. Base the waste determination upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, EPA approved analytical data, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate). Attach all support documentation to the Waste Determination form. As a minimum, a Waste Determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.

3.5 POLLUTION PREVENTION/HAZARDOUS WASTE MINIMIZATION

Minimize the use of hazardous materials and the generation of hazardous waste. Include procedures for pollution prevention/ hazardous waste minimization in the Hazardous Waste Management Section of the Environmental Protection Plan. Consult with the activity Environmental Office for suggestions and to obtain a copy of the installation's pollution prevention/hazardous waste minimization plan for reference material when preparing this part of the plan. If no written plan exists, obtain information by contacting the Contracting Officer. Describe the types of the hazardous materials expected to be used in the construction when requesting information.

3.6 WASTE HAZARDOUS MATERIAL (WHM)/HAZARDOUS WASTE (HW) MATERIALS PROHIBITION

No waste hazardous material or hazardous waste shall be disposed of on government property. No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract. The government is not responsible for disposal of Contractor's waste material brought on the job site and not required in the performance of this contract. The intent of this provision is to dispose of that waste identified as waste hazardous material/hazardous waste as defined herein that was generated as part of this contract and existed within the boundary of the Contract limits and not brought in from offsite by the Contractor. Incidental materials used to support the contract including, but not limited to aerosol cans, waste paint, cleaning solvents, contaminated brushes, rags, clothing, etc. are the responsibility of the Contractor. The list is illustrative rather than inclusive. The Contractor is not authorized to discharge any materials to sanitary sewer, storm drain, or to the river or conduct waste treatment or disposal on government property without written approval of the Contracting Officer.

3.7 HAZARDOUS MATERIAL MANAGEMENT

Include hazardous material control procedures in the Safety Plan. Address procedures and proper handling of hazardous materials, including the appropriate transportation requirements. No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract. Submit a MSDS and estimated quantities to be used for each hazardous material to the Contracting Officer prior to bringing the material on base. Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents,

adhesives, aerosol, and petroleum products. Ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. Ensure that all containers of hazardous materials have NFPA labels or their equivalent. Certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

3.7.1 Contractor Hazardous Material Inventory Log

Submit the "Contractor Hazardous Material Inventory Log"(found at: http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf), which provides information required by (EPCRA Sections 312 and 313) along with corresponding Material Safety Data Sheets (MSDS), to the Contracting Officer at the start and at the end of construction (30 days from final acceptance), and update no later than January 31 of each calendar year during the life of the contract. Keep copies of the MSDS for hazardous materials on site at all times. At the end of the project, provide the Contracting Officer with copies of all of these MSDS, and the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used.

Documentation for any spills/releases, environmental reports or off-site transfers may be requested by the Contracting Officer.

3.8 PETROLEUM PRODUCTS AND REFUELING

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. Provide a spill kit on site and train staff in use of kit. Limit the storage of all fuels, lubricants, solvents, paints and hazardous substances to a total of less than 55 gallons on site. Manage all used oil generated on site in accordance with 40 CFR 279. Determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. Used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste.

3.8.1 Oily and Hazardous Substances

Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with a temporary berm or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm will be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs. Provide general secondary containment for oil transfer operations as required by 40 CFR 112.7.

3.8.2 Inadvertent Discovery of Petroleum Contaminated Soil or Hazardous Wastes

If petroleum contaminated soil or suspected hazardous waste is found during construction that was not identified in the contract documents, the contractor shall immediately notify the contracting officer. The contractor shall not disturb this material until authorized by the contracting officer.

3.9 FUEL TANKS

Total storage of all fuels and all solvents is 55 gallons without approval by the Government. Storage and refilling practices shall comply with 40 CFR Part 112. Secondary containment shall be provided and be no less than 110 percent of the tank volume plus five inches of free-board. If a secondary berm is used for containment then the berm shall be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs. Drips pans are required and the tanks must be covered during inclement weather.

3.10 RELEASES/SPILLS OF OIL AND HAZARDOUS SUBSTANCES

Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated by environmental law. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release. The site plan shall include where any fuels, hazardous substances, solvents or lubricants will be stored. The spill plan is to address any leaks or spills of fuels, hazardous substances, solvents or lubricants. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the Base or Activity Fire Department, the activity's Command Duty Officer, and the Contracting Officer. If the contractor's response is inadequate, the Navy may respond. If this should occur, the contractor will be required to reimburse the government for spill response assistance and analysis.

The Contractor is responsible for verbal and written notifications as required by the federal 40 CFR 355, State, local regulations and Navy Instructions. Spill response will be in accordance with 40 CFR 300 and applicable State and local regulations. Contain and clean up these spills without cost to the Government. If Government assistance is requested or required, the Contractor will reimburse the Government for such assistance. Provide copies of the written notification and documentation that a verbal notification was made within 20 days.

Maintain spill cleanup equipment and materials at the work site. Clean up all hazardous and non-hazardous (WHM) waste spills. The Contractor shall reimburse the government for all material, equipment, and clothing generated during any spill cleanup. The Contractor shall reimburse the government for all costs incurred including sample analysis materials, equipment, and labor if the government must initiate its own spill cleanup procedures, for Contractor responsible spills, when:

a. The Contractor has not begun spill cleanup procedure within one hour of spill discovery/occurrence, or

b. If, in the government's judgment, the Contractor's spill cleanup is not adequately abating life threatening situation and/or is a threat to any body of water or environmentally sensitive areas.

3.11 CONTROL AND MANAGEMENT OF ASBESTOS CONTAINING MATERIAL (ACM)

Items, components, or materials disturbed by or included in work under this contract do involve asbestos. Other materials in the general area around

where work will be performed may contain asbestos. All thermal insulation, in all work areas, should be considered to be asbestos unless positively identified by conspicuous tags or previous laboratory analysis certifying them as asbestos free.

Inadvertent discovery of non-disclosed asbestos that will result in an abatement action requires a change in scope before proceeding. Upon discovery of asbestos containing material not identified in the contract documents, the Contractor shall immediately stop all work that would generate further damage to the material, evacuate the asbestos exposed area, and notify the Contracting Officer for resolution of the situation prior to resuming normal work activities in the affected area. Do not remove or perform work on any asbestos containing materials without the prior approval of the Contracting Officer. Do not engage in any activity, which would remove or damage such materials or cause the generation of fibers from such materials.

Manage and dispose of asbestos containing waste in accordance with applicable environmental law. Asbestos containing waste shall be manifested and the manifest provided to the Contracting Officer.

3.12 CONTROL AND MANAGEMENT OF HAZARDOUS WASTES

3.12.1 Facility Hazardous Waste Generator Status

N.A.S. Corpus Christi is designated as a Large Quantity Generator . All work conducted within the boundaries of this activity must meet the regulatory requirements of this generator designation. Comply with all provisions of Federal, State and local regulatory requirements applicable to this generator status regarding training and storage, handling, and disposal of all construction derived wastes.

3.12.2 Hazardous Waste/Debris Management

Identify all construction activities which will generate hazardous waste/debris. Provide a documented waste determination for all resultant waste streams. Hazardous waste/debris will be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268.

Hazardous waste will also be managed in accordance with the approved Hazardous Waste Management Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities will be identified as being generated by the Government.

Prior to removal of any hazardous waste from Government property, all hazardous waste manifests must be signed by activity personnel from the Station Environmental Office. No hazardous waste must be brought onto Government property. Provide to the Contracting Officer a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the Contracting Officer immediately.

3.12.2.1 Regulated Waste Storage/Satellite Accumulation/90 Day Storage Areas

If the work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor will request the establishment of a Regulated Waste Storage Area, a Satellite Accumulation Area, or a 90 Day Storage Area at the point of generation. The Contractor must submit a request in writing to the Contracting Officer providing the following information:

Contract Number	_____
Contractor	_____
Haz/Waste or Regulated Waste POC	_____
Phone Number	_____
Type of Waste	_____
Source of Waste	_____
Emergency POC	_____
Phone Number	_____
Location of the Site	_____

(Attach Site Plan to the Request)

Attach a waste determination form. Allow ten working days for processing this request. The designated area where waste is being stored shall be barricaded and a sign identifying as follows:

"DANGER - UNAUTHORIZED PERSONNEL KEEP OUT"

3.12.2.2 Sampling and Analysis of Hazardous Waste (HW)

a. Waste Sampling

Sample waste in accordance with EPA 530/F-93/004. Each sampled drum or container will be clearly marked with the Contractor's identification number and cross referenced to the chemical analysis performed.

b. Laboratory Analysis

Follow the analytical procedure and methods in accordance with the 40 CFR 261. The Contractor will provide all analytical results and reports performed to the Contracting Officer

c. Analysis Type

Identify waste hazardous material/hazardous waste by analyzing for the following properties as a minimum: ignitability, corrosiveness, total chlorides, BTU value, PCBs, TCLP for heavy metals, and cyanide.

3.12.2.3 Hazardous Waste Disposal

No hazardous, toxic, or universal waste shall be disposed or hazardous material abandoned on government property. And unless otherwise noted in this contract, the government is not responsible for disposal of Contractor generated waste material. The disposal of incidental materials used to accomplish the work including, but not limited to aerosol cans, waste paint, cleaning solvents, contaminated brushes, rags, clothing, etc. are the responsibility of the Contractor. The list is illustrative rather than inclusive.

The Contractor is not authorized to discharge any materials to sanitary sewer, storm drain, or water way or conduct waste treatment or disposal on government property without written approval of the Contracting Officer.

Control of stored waste, packaging, sampling, analysis, and disposal will be determined by the details in the contract. The requirements for jobs in the following paragraphs will be used as the guidelines for disposal of any hazardous waste generated.

a. Responsibilities for Contractor's Disposal

Contractor responsibilities include any generation of WHM/HW requiring Contractor disposal of solid waste or liquid.

(1) Provide all service necessary for the final treatment/disposal of the hazardous material/waste in accordance with all local, State and Federal laws and regulations, and the terms and conditions of the contract within sixty (60) days after the materials have been generated. These services will include all necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal, and/or transportation, including manifesting or completing waste profile sheets, equipment, and the compilation of all documentation is required).

(2) Contain all waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 272, 40 CFR 273, 40 CFR 279, 40 CFR 280, and 40 CFR 761.

(3) Obtain a representative sample of the material generated for each job done to provide waste stream determination.

(4) Analyze each sample taken and providing analytical results to the Contracting Officer. Provide two copies of the results.

(5) Determine the DOT proper shipping names for all waste (each container requiring disposal) and will demonstrate how this determination is developed and supported by the sampling and analysis requirements contained herein to the Contracting Officer.

Contractor Disposal Turn-In Requirements

For any waste hazardous materials or hazardous waste generated which requires the Contractor to dispose of, the following conditions must be complied with in order to be acceptable for disposal:

(1) Drums compatible with waste contents and drums meet DOT requirements for 49 CFR 173 for transportation of materials.

(2) Drums banded to wooden pallets. No more than three (3) 55 gallon drums to a pallet, or two (2) 85 gallon over packs.

(3) Band using 1-1/4 inch minimum band on upper third of drum.

(4) Recovery materials label (provided by Code 106.321) located in middle of drum, filled out to indicate actual volume of material, name of material manufacturer, other vendor information as available.

(5) Always have three (3) to five (5) inches of empty space above volume of material. This space is called 'outage'.

3.12.2.4 Universal Waste/e-Waste Management

Universal waste including but not limited to some mercury containing building products such florescent lamps, mercury vapor lamps, high pressure sodium lamps, CRTs, batteries, aerosol paint containers, electrical equipment containing PCBs, and consumed electronic devices, shall be managed in accordance with applicable environmental law and installation instructions.

3.12.3 Class I ODS Prohibition

Class I in pure or blended form as defined and identified herein must not be used in the performance of this contract, nor be provided as part of the equipment except for the use of servicing existing government owned equipment. This prohibition will be considered to prevail over any other provision, specification, drawing, or referenced documents.

3.12.3.1 Recycling Requirements

Recycle used refrigerants and ozone depleting substances generated during the performance of this contract to the maximum extent practicable to minimize used refrigerant and ozone depleting substance disposal as HW.

Test, collect, transfer, recycle, and/or arrange for shipping and proper disposal of used refrigerants and ozone depleting substances generated during the performance of work under this contract. The Contractor is responsible for all associated costs.

Any and all Class I ODS and R-22 recovered by the Contractor as part of this contract shall be packaged and turned over to the Government for recycling upon the completion of the work covered by this contract. The Contractor shall arrange for recycling of used refrigerants not turned over to the government, at a licensed refrigerant recycler approved by the Contracting Officer.

3.12.3.2 EPA Certification Requirements

Heating and air conditioning technicians must be certified through an EPA-approved program. Copies of certifications shall be maintained at the employees' place of business and be carried as a wallet card by the technician, as provided by environmental law. .

3.12.3.3 Accidental Venting of Refrigerant

Accidental venting of a refrigerant is a release and must be reported to the Contracting Officer

3.13 DUST CONTROL

Keep dust down at all times, including during 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 unnecessarily shake bags of cement, concrete mortar, or plaster.

3.13.1 Dirt and Dust Control Plan

Submit truck and material haul routes along with a plan for controlling dirt, debris, and dust on base roadways. As a minimum, identify in the plan the subcontractor and equipment for cleaning along the haul route and measures to reduce dirt, dust, and debris from roadways.

3.14 ABRASIVE BLASTING

3.14.1 Blasting Operations

The use of silica sand is prohibited in sandblasting.

Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive, agent, paint chips, and other debris .

3.14.2 Disposal Requirements

Submit analytical results of the debris generated from abrasive blasting operations per Laboratory Analysis in paragraph SAMPLING AND ANALYSIS OF HW. Hazardous waste generated from blasting operations will be managed in accordance with paragraph CONTROL AND MANAGEMENT OF HAZARDOUS WASTE and with the approved HWMP.

3.15 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 the 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 specified.

3.16 MERCURY MATERIALS

Mercury is prohibited in the construction of this facility, unless specified otherwise, and with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed. Immediately report to the Environmental Office and

the Contracting Officer instances of breakage or mercury spillage. Clean mercury spill area to the satisfaction of the Contracting Officer.

Cleanup of a mercury spill shall not be recycled and shall be managed as a hazardous waste for disposal.

-- End of Section --

SECTION 01 58 00.00 25

PROJECT IDENTIFICATION
12/14
NAVFAC SE VERSION

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 PROTECTION 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

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Preliminary drawing indicating layout and text content; G

1.3 PROJECT SIGN

Prior to initiating any work on site, provide one project identification sign at the location designated. Construct the sign in accordance with project sign detail, which can be downloaded at: http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf. Maintain sign throughout the life of the project. Upon completion of the project, remove the sign from the site.

1.3.1 Project Identification Signboard (Navy)

Provide preliminary drawing indicating layout and text content. The signboard shall be provided at a conspicuous location on the job site where directed by the Contracting Officer.

a. The field of the sign shall consist of a 4 by 8 foot sheet of grade B-B medium density overlaid exterior plywood.

b. Lumber shall be B or better Southern pine, pressure-preservative treated in accordance with AWPA C1 and AWPA C2. Nails shall be aluminum or galvanized steel.

c. The entire signboard and supports shall be given one coat of exterior alkyd primer and two coats of exterior alkyd enamel paint. The

lettering and sign work shall be performed by a skilled sign painter using paint known in the trade as bulletin colors. The colors, lettering sizes, and lettering styles shall be as indicated. Where preservative-treated lumber is required, utilize only cured pressure-treated wood which has had the chemicals leached from the surface of the wood prior to painting.

d. Use spray applied automotive quality high gloss acrylic white enamel paint as background for the NAVFAC logo. NAVFAC logo shall be an applied 2 mil film sticker/decal with either transparent or white background or paint the logo by stencil onto the sign. The weather resistant sticker/decal film shall be rated for a minimum of 2-year exterior vertical exposure. The self-adhering sticker shall be mounted to the sign with pressure sensitive, permanent acrylic adhesive. Shop cut sticker/decal to rectangular shape and provide pull-off backing sheet on adhesive side of design sticker for shipping.

e. Sign paint colors (manufacturer's numbers/types listed below for color identification only)

(1) Blue = To match dark blue color in the NAVFAC logo.

(2) White = To match Brilliant White color in the NAVFAC logo.

f. NAVFAC logo must retain proportions and design integrity. NAVFAC logos in electronic format may be obtained from the NAVFAC web portal via the following link:
https://portal.navfac.navy.mil/portal/page?_pageid=181,3465071&_dad=portal&_schema=p
Use the following to choose color values for the paint to be used:

(1) Dark Blue = equivalent to CMYK values 100, 72, 0, 8 .

(2) Light Blue = equivalent to CMYK values 69, 34, 0, 0.

(3) Cyan = equivalent to CMYK values 100, 9, 0, 6.

(4) Yellow = equivalent to CMYK values 0.9,94, 0.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 74 19.00 25

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
12/14
NAVFAC SE VERSION

PART 1 GENERAL

1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 75 percent by weight of total project solid waste shall be diverted from the landfill.

1.2 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. The Environmental Manager, as specified in Section 01 57 19.00 25 Temporary Environmental Controls, shall be responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the project. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan; G

SD-11 Closeout Submittals

Records

1.4 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01 45 00.25 QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

a. Pre-bid meeting.

b. Preconstruction meeting.

c. Regular QC meetings.

d. Work safety meetings.

1.5 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after contract award and not less than 10 days before the preconstruction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for

reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.6 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.7 REPORTS

Provide quarterly reports and a final report to the Contracting Officer. Quarterly and final reports shall include project name, information for waste generated this quarter, and cumulative totals for the project. Each report shall include supporting documentation to include manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. Include timber harvest and demolition information, if any.

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers,

bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 57 19.00 25 TEMPORARY ENVIRONMENTAL CONTROLS. Separate materials by one of the following methods:

1.8.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

(1) Ferrous.

(2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

(1) Bond.

(2) Newsprint.

(3) Cardboard and paper packaging materials.

i. Plastic.

Type	
1	Polyethylene Terephthalate (PET, PETE)
2	High Density Polyethylene (HDPE)
3	Vinyl (Polyvinyl Chloride or PVC)
4	Low Density Polyethylene (LDPE)
5	Polypropylene (PP)
6	Polystyrene (PS)
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.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Insulation.

1.8.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.8.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.9 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.9.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with the Contracting Officer. Reuse materials as indicated on the drawings. Sale or donation of waste suitable for reuse shall be considered.

1.9.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps,

HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.9.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.9.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 75 00.00 25

STARTING AND ADJUSTING
12/14
NAVFAC SE VERSION

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

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. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29.00 25 SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan; G

Manufacturer's Sample Warranty; G

Operation and Maintenance Data; G

SD-02 Shop Drawings

Drawings, Diagrams and Schedules; G

Diagrams and Instructions; G

SD-03 Product Data

Catalog Cuts; G

Samples of Warranty Language; G

SD-06 Test Reports

Factory Tests; G

Functional Field Test; G

SD-07 Certificates

Qualification of Manufacturer; G

Qualification of Applicator or Installer; G

SD-08 Manufacturer's Instructions

Manufacturer's Administrative Requirements; G

Demonstration and Training Information; G

Manufacturer's Procedural Requirements; G

SD-09 Manufacturer's Field Reports

Documentation of the Testing and Verification Actions; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Data; G

1.2.1 Preconstruction and Pre-Testing Requirements

Deliver equipment and services to meet the requirements and specifications of their respective contract. Ensure all equipment is free of latent manufacturing and installation defects. The Government reserves the option to elect performance of acceptance testing by internal personnel, or a designated third party. Regardless of who performs the acceptance testing, ensure the requirements of acceptance are met by the Contractor.

Submit the following for review and approval prior to the commencement of work and any testing, whether such testing is on site or elsewhere:

a. Verification of prior experience and expertise with similar project scope

b. Documentation of manufacturer's prior experience and expertise with similar project materials and systems

c. Quality control plan

d. Manufacturer's sample warranty and operation and maintenance data, with details regarding start-up procedures

e. Manufacturer's administrative requirements

f. Manufacturer's procedural requirements

g. Demonstration and training information

Submit the following certifications:

a. Provide evidence that products used within this specification are manufactured in the United States.

b. Qualification of manufacturer, including current licenses and insurance.

c. Qualification of applicatorinstaller, including licenses and insurance.

1.2.2 Shop Drawings and Diagrams

Submit the following shop drawings, record drawings, and diagrams as required to correctly execute the installation of the work:

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

b. 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

c. Coordination drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated

1.2.3 Product and Design Data

Submit all product data and any design calculations, mix designs, analyses or other data pertaining to the work to ensure a complete functional installation; including, but not limited to:

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

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

c. Operation and maintenance data provided by the manufacturer to ensure the safe and efficient operation, maintenance and repair of the system or equipment provided

d. Safety and security data or posters provided by the manufacturer to be posted in a conspicuous visible location for operational and maintenance personnel

1.2.4 Tests Required

Perform tests to verify proper functioning of fire protection, fire suppression, HVAC, compressed air, electrical switchgear, protective relaying, fluid and gas systems, pump/motor combinations, boiler systems, hydraulic and pneumatic control, condition/performance monitoring systems, energy control and monitoring systems, and other assemblies and components that need to be tested as an interrelated whole.

1.2.4.1 Factory Tests

Submit certified copies of required tests performed at the factory to verify proper build. These test results will be used in the "Final Acceptance Test" section to verify no shipping damage and proper installation.

1.2.4.2 Functional Field Test

Perform functional field tests to verify that the system and components have been properly installed, are ready for startup, and are functioning properly. Perform test(s) in the presence of the Contracting Officer. Acceptance will be issued when system has performed per other sections and referenced industry standards.

Coordinate and submit documentation of the testing and verification actions taken by manufacturer's representative on any portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 00.00 25

CLOSEOUT SUBMITTALS
12/14
NAVFAC SE VERSION

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.

GREEN SEAL (GS)

GS-37	(2012) Cleaning Products for Industrial and Institutional Use

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-300-08	(2009, with Change 2) Criteria for Transfer and Acceptance of DoD Real Property

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials
Warranty Management Plan
Warranty Tags
Spare Parts Data

SD-08 Manufacturer's Instructions

Preventative Maintenance
Condition Monitoring (Predictive Testing)
Inspection
Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings
Interim Form DD1354; G
Checklist for Form DD1354; G
NAVFAC Sustainable & Energy Data Record Card; G

1.3 PROJECT RECORD DOCUMENTS

1.3.1 Record Drawings

Drawings showing final as-built conditions of the project. This paragraph covers record drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions.

1.3.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file record drawings.

1.3.1.2 Working Record and Final Record Drawings

Revise sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. Keep these working as-built marked drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Prepare final record (as-built) drawings after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final record (as-built) drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final record drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. Show on the working and final record drawings , but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from

working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, show only the option selected for construction on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.

(1) Follow directions in the modification for posting descriptive changes.

(2) Place a Modification Delta at the location of each deletion.

(3) For new details or sections which are added to a drawing, place a Modification Delta by the detail or section title.

(4) For minor changes, place a Modification Delta by the area changed on the drawing (each location).

(5) For major changes to a drawing, place a Modification Delta by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, place a Modification Delta either by the schedule heading or by the change in the schedule.

1.3.1.3 Drawing Preparation

Modify the record drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this project and must be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

1.3.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only employ personnel proficient in the preparation of CADD drawings to modify the contract drawings or prepare additional new drawings. Additions and corrections to the contract drawings must be equal in quality and

detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols must be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, prepare them using the specified electronic file format applying. The title block and drawing border to be used for any new final record drawings must be identical to that used on the contract drawings. Accomplish additions and corrections to the contract drawings using CADD files. The Contractor will be furnished "as-designed" drawings in AutoCad format. The electronic files will be supplied on optical disk. Provide all program files and hardware necessary to prepare final record drawings. The Contracting Officer will review final record drawings for accuracy and return them to the Contractor for required corrections, changes, additions, and deletions.

a. When final revisions have been completed, show the wording "RECORD DRAWINGS / AS-BUILT CONDITIONS" followed by the name of the Contractor in letters at least 3/16 inch high on the cover sheet drawing. Mark all other contract drawings either "Record" drawing denoting no revisions on the sheet or "Revised Record" denoting one or more revisions. Date original contract drawings in the revision block.

b. Within 20 days after Government approval of all of the working record drawings for a phase of work, prepare the final CADD record drawings for that phase of work and submit two sets of hard-copy prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 10 days revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 20 days of substantial completion of all phases of work, submit the final record drawing package for the entire project. Submit three sets of electronic files on optical disk, two sets of hard-copy prints and one set of the approved working record drawings. Of the three optical discs, submit two to the Contracting Officer for distribution to the Designer-of-Record and Public Works, and forward one to NAVFAC SE Asset Management GI&S, Southeast GeoReadiness Center Manager, NAS Jacksonville, Jacksonville, FL 32212. They must be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this are the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final record drawing files and marked prints as specified will be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final record drawings must be accomplished before final payment is made to the Contractor.

1.3.1.5 Payment

No separate payment will be made for record drawings required under this contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.3.2 As-Built Record of Equipment and Materials

Furnish one copy of preliminary record of equipment and materials used on

the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Submit Two sets of final record of equipment and materials 10 days after final inspection. Key the designations to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA				
Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.3.3 Final Approved Shop Drawings

Furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.3.4 Construction Contract Specifications

Furnish final record (as-built) construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.3.5 Real Property Equipment

Furnish a list of installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Furnish a draft list at time of transfer. Furnish the final list 30 days after transfer of the completed facility.

1.4 SPARE PARTS DATA

Submit two copies of the Spare Parts Data list.

a. Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

b. Supply 5 items of each part for spare parts inventory. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.5 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance, Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

a. Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements

within the schedule. Provide a signoff blank for the Contractor and Contracting Officer for each test feature; e.g., gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.6 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and Estimate of Percentage of Recovered Material Content for EPA Designated Items". Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials: 1) The product does not meet appropriate performance standards; 2) The product is not available within a reasonable time frame; 3) The product is not available competitively (from two or more sources); 4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product). Record each product used in the project that has a requirement or option of containing recycled content, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, exemptions (1, 2, 3, or 4, as indicated), and comments. Recycled content values may be determined by weight or volume percent, but must be consistent throughout.

1.7 WARRANTY MANAGEMENT

1.7.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to the clause Warranty of Construction in FAR 52. 246-21. At least 30 days before the planned pre-warranty conference, submit two of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of project acceptance and continue for the full product warranty period. A joint 4 month and 9 month warranty inspection will be conducted, measured from time of acceptance, by the

Contractor, Contracting Officer and the Customer Representative. Include within the warranty management plan , but not limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subContractors, manufacturers or suppliers involved.

b. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

c. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

d. A list for each warranted equipment, item, feature of construction or system indicating:

(1) Name of item.
(2) Model and serial numbers.
(3) Location where installed.
(4) Name and phone numbers of manufacturers or suppliers.
(5) Names, addresses and telephone numbers of sources of spare parts.
(6) Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
(7) ross-reference to warranty certificates as applicable.
(8) Starting point and duration of warranty period.
(9) Summary of maintenance procedures required to continue the warranty in force.
(10) Cross-reference to specific pertinent Operation and Maintenance manuals.
(11) Organization, names and phone numbers of persons to call for warranty service.
(12) Typical response time and repair time expected for various warranted equipment.

e. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

f. Procedure and status of tagging of all equipment covered by extended warranties.

g. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.7.2 Performance Bond

The Contractor's Performance Bond must remain effective throughout the construction period .

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited

to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.7.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, be continuously available, and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.7.4 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also, submit two record copies of the warranty tags showing the layout and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

Type of product/material	
Model number	
Serial number	
Contract number	
Warranty period from/to	
Inspector's signature	
Construction Contractor	

Address	
Telephone number	
Warranty contact	
Address	
Telephone number	
Warranty response time priority code	
WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.	

1.8 COMMISSIONING

1.8.1 Building Commissioning

All contract requirements for building commissioning shall be completed prior to contract completion.

1.9 OPERATION AND MAINTENANCE MANUALS

Submit 6 copies of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.9.1 Configuration

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Bind information in manual format and grouped by technical sections. Test data must be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals must have 0.3937-inch holes and be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Caution and warning indications must be clearly labeled.

1.9.2 Training and Instruction

Submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services must be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. Contracting Officer will be given 7 calendar days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, must be made available to the Contracting Officer.

1.10 CLEANUP

Leave premises "broom clean." Comply with GS-37 for general purpose cleaning and bathroom cleaning. Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. 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 and comply with the Indoor Air Quality (IAQ) Management Plan. 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. Recycle, salvage, and return construction and demolition waste from project in accordance with the Waste Management Plan. Promptly and legally transport and dispose of any trash. Do not burn, bury, or otherwise dispose of trash on the project site.

1.10.1 Extraordinary Cleanup Requirements

The following cleanup requirements apply: All paved surfaces must be swept and cleaned to remove all debris which could damage an aircraft.

1.11 REAL PROPERTY RECORD

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, completeand submit an accounting of all installed property with Interim Form DD1354 "Transfer and Acceptance of Military Real Property." Include any additional assets/improvements/alterations from the Draft DD Form 1354. Contact the Contracting Officer for any project specific information necessary to complete the DD Form 1354. Refer to UFC 1-300-08 for instruction on completing the DD Form 1354. For information purposes, a blank DD Form 1354 (fill-able) in ADOBE (PDF) may be obtained at the following web site:
http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd1354.pdf

Submit the completed Checklist for Form DD1354 of Installed Building Equipment items. Attach this list to the updated DD Form 1354.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 23.00 25

OPERATION AND MAINTENANCE DATA
03/15
NAVFAC SE VERSION

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.

ASTM INTERNATIONAL (ASTM)

ASTM E1971	(2005; R 2011) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors must compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor must compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.2.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections must use Data Package 3.

1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data must be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 Review and Approval

The Contractor's Commissioning Authority (CA) must review the commissioned systems and equipment submittals for completeness and applicability. The CA must verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. The CA must communicate deficiencies to the Contracting Officer. Upon a successful review of the corrections, the CA must recommend approval and acceptance of these O&M manuals to the Contracting Officer. This work is in addition to the normal review procedures for O&M data.

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.3.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for all operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26.00 25 GOVERNMENT SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

1.3.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.3.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.3.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as

lubrication, adjustment, inspection, and recording gage readings.

1.3.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.3.1.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary operating records.

1.3.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.3.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.3.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E1971.

1.3.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.3.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.3.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.3.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.3.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.3.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.3.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.3.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.3.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required

in the applicable technical sections.

1.3.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.3.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.3.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.3.5.6 Extended Warranty Information

List all warranties for products, equipment, components, and sub-components whose duration exceeds one year. For each warranty listed, indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference all specific operation and maintenance procedures that must be performed to keep the warranty valid.

1.3.5.7 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.3.5.8 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.3.5.9 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.3.5.10 Test Reports & Manufacturer's Reports

Provide Test Reports (SD-06) & Manufacturer's Field Reports (SD-09) that apply to equipment associated with the system.

1.3.5.11 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.4 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of all checkout tests and calibrations performed by the Contractor (not Cx tests).

d. Full print out of all schedules and set points after testing and acceptance of the system.

e. Full as-built print out of software program.

f. Electronic File:

(1) Assemble each manual into a composite electronically indexed file in PDF format. Provide HDD’s, DVD's or CD's as appropriate, so that each one contains all maintenance and record files, and also the Project Record Documents and Training Videos, of the entire program for this facility.

(2) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

(3) Link the index to separate files within the composite of files. Book mark maintenance and record files, that have a Table of Contents, according to the Table of Contents

h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.5 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.5.1 Data Package 1

a. Safety precautions

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Contractor information

f. Spare parts and supply list

1.5.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Contractor information

1.5.3 Data Package 3

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Lubrication data

h. Preventive maintenance plan and schedule

i. Cleaning recommendations

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Product submittal data

p. O&M submittal data

q. Parts identification

r. Warranty information

s. Testing equipment and special tool information

t. Testing and performance data

u. Contractor information

1.5.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Corrective maintenance man-hours

q. Product submittal data

r. O&M submittal data

s. Parts identification

t. Warranty information

u. Personnel training requirements

v. Testing equipment and special tool information

w. Testing and performance data

x. Contractor information

1.5.5 Data Package 5

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Testing and performance data

s. Contractor information

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 24.00 25

FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI)
03/15
NAVFAC SE VERSION

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. DEPARTMENT OF DEFENSE (DOD)

FC 1-300-09N	(2014) Navy and Marine Corps Design Procedures

1.2 DEFINITIONS AND ABBREVIATIONS

1.2.1 eOMSI Manual

Manual (PDF file) provided by the Contractor that includes, but is not limited to, product information, a facility description with photos, and a list of primary facility systems.

1.2.2 eOMSI Facility Data Workbook (FDW)

A Microsoft Excel spreadsheet containing 17 facility asset fields to be populated with the required information by the Contractor.

1.2.3 Systems

The words "system", "systems", and "equipment", when used in this document refer to as-built systems and equipment.

1.2.4 Computer Assisted Design and Drafting (CADD)

Electronic Computer Assisted Design and Drafting graphic software program that is used to create facility design contract documents and Record Drawings.

1.2.5 KTR

An abbreviation for "Contractor."

1.3 EOMSI MEETINGS

1.3.1 Pre-Construction Meeting

Be prepared to discuss the following during this meeting:

a. eOMSI Manual and eOMSI Facility Data Workbook Development Meetings

b. Processes and methods of gathering eOMSI Manual and eOMSI Facility Data Workbook information during construction.

c. The eOMSI Submittals schedule. Include the eOMSI submittal schedule on the Baseline Construction Schedule in accordance with Section 01 32 17.00 25 COST-LOADED NETWORK ANALYSIS SCHEDULE (NAS).

1.3.2 eOMSI Manual and Facility Data Workbook Coordination and Mutual Understanding Meeting

Facilitate a meeting after the Pre-Construction Meeting prior to the submission of the eOMSI Progress Submittal. Meeting attendance must include the Contractor's eOMSI Manual and Facility Data Workbook Preparer, Designer of Record (DOR), and Quality Control Manager, the Commissioning Authority (CA), and the Government's Design Manager (DM), Contracting Officer's Representative, and NAVFAC Public Works (PW) Facilities Management Division (FMD). Also include the Mechanical, Electrical, and Fire Protection Sub-Contractors as required.

The purpose of this meeting is to reach a mutual understanding of the scope of work concerning the contract requirements for eOMSI and coordinate the efforts necessary by both the Government and Contractor to ensure an accurate collection, preparation and timely Government review of eOMSI.

1.3.3 Facility Turnover Meeting

Include eOMSI in Red Zone (NRZ) facility turnover meetings as specified in Section 01 30 00.00 25, ADMINISTRATIVE REQUIREMENTS.

1.4 SUBMITTAL SCHEDULING

1.4.1 eOMSI, Progress Submittal

Submit the Progress submittal when construction is approximately 50 percent complete, to the Contracting Officer for approval. Provide eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). Include all elements and portions of system construction completed up to this point.

The purpose of this submittal is to verify progress is in accordance with contract requirements as discussed during the eOMSI Coordination and Mutual Understanding Meeting. Field verify a portion of the eOMSI information in accordance with paragraph FIELD VERIFICATION.

1.4.2 eOMSI, Prefinal Submittal

Submit the 100 percent submittal of the eOMSI Prefinal Submittal to the Contracting Officer for approval within 60 calendar days of the Beneficial Occupancy Date (BOD). This submittal must provide a complete, working document that can be used to operate and maintain the facility. Any portion of the submittal that is incomplete or inaccurate requires the entire submittal to be returned for correction. Any discrepancies discovered during the Government's review of eOMSI Progress submittal must be corrected prior to the Prefinal submission.

The eOMSI Prefinal Submittal must include eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel).

1.4.3 eOMSI, Final Submittal

Submit completed eOMSI Manual Files (Bookmarked PDF) and eOMSI Facility Data Workbook (Excel). The Final submittal is due at BOD. Any discrepancies discovered during the Government's review of the Prefinal

eOMSI submittal, including the Field Verification, must be corrected prior to the Final eOMSI submission.

1.5 UNITS OF MEASURE

Provide eOMSI utilizing the units of measure used in the Government generated contract documents.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Training Plan; G

Training Outline; G

Training Content; G

SD-11 Closeout Submittals

eOMSI, Progress Submittal; G

eOMSI, Prefinal Submittal; G

eOMSI, Final Submittal; G

Training Video Recording; G

Validation of Training Completion; G

PART 2 PRODUCTS

2.1 eOMSI FILES FORMAT

Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains all maintenance and record files, and Project Record Documents and Training Videos. Include a complete electronically linked operation and maintenance directory. Provide four electronic copies of the eOMSI Manuals to the Contracting Officer for approval.

Provide eOMSI Facility Data Workbook on compact disks (CD) or data digital versatile disk (DVD) disks in (EXCEL) format. Scan eOMSI Manual Files and eOMSI Facility Data Workbook for malicious viruses using a commercially available scanning program that is routinely updated to identify and remove current virus threats.

2.1.1 eOMSI Manual Organization

Organize the eOMSI Manuals into two parts: 1) Product and Drawing Information, and 2) Facility Information. Bookmark the PDF files for easy access to the information.

a. Bookmark Facility Information and Primary Systems to at least one level lower than the major system.

b. Bookmark Product and Drawing Information documents using the current version of CSI Masterformat numbering system, and arrange submittals using the specification sections as a structure. Use CSI Masterformat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

2.1.2 eOMSI Manual Compact Disk Label and Disk Holder or Case

Provide the following information on the compact disk label and disk holder or case:

a. Building Number

b. Project Title

c. Activity and Location

d. Construction Contract Number

e. Prepared For: (Contracting Agency)

f. Prepared By: (Name, title, phone number and email address)

g. Include the compact disk content on the disk label

h. Date

i. Virus scanning program used

2.2 EOMSI MANUAL

2.2.1 Product and Drawing Information

Provide an organized record of the facility products, materials, equipment, and minimum information necessary to operate the facility. Provide Product and Drawing Information for all systems in the final constructed facility. Organize and bookmark the information for easy access and quick retrieval.

2.2.1.1 O&M Data

As a minimum, include the O&M Data, submitted in the technical specification sections, and in accordance with Section 01 78 23.00 25 OPERATION AND MAINTENANCE DATA.

2.2.1.2 Record Drawings

Provide an electronic, PDF copy of the Record Drawings, prepared in accordance with FC 1-300-09N and Section 01 78 00.00 25 CLOSEOUT SUBMITTALS. Bookmark all drawings using the sheet title and sheet number.

Include Record Drawings as part of the Red-Zone in accordance with Section 01 30 00.00 25 ADMINISTRATIVE REQUIREMENTS.

2.2.1.3 Utility Record Drawings

Using Record Source Drawings, show and document details of the actual installation of the utility systems; annotate and highlight the eOMSI information. Provide Utility Record Drawings in PDF format. Provide the following drawings at a large enough scale to differentiate designated isolation units from surrounding valves and switches.

a. Utility Schematic Diagrams - Provide a one line schematic diagram for each utility system such as power, water, wastewater, and gas/fuel. Schematic diagram must show from the point where the utility line is connected to the mainline up to the 5 foot connection point to the facility. Indicate location or area designation for route of transmission or distribution lines; locations of duct banks, manholes/ handholes or poles; isolation units such as valves and switches; and utility facilities such as pump stations, lift stations, and substations.

b. Enlarged Connection and Cutoff Plans - Provide enlarged floor plans that provide information between the 5 foot utility connection point and where utilities connect to facility distribution. Enlarge floor plans / elevations of the rooms where the utility enters the building and indicate on these plans locations of the main interior and exterior connection and cutoff points for all utilities. Also enlarge floor plans / elevations of the rooms where equipment is located. Include enough information to enable someone unfamiliar with the facility to locate the connection and cutoff points. Indicate designations such as room number, panel number, circuit breaker, or valve number, of each utility and equipment connection and cutoff point, and what that connection and cutoff point controls.

2.2.2 Facility Information

Provide the following in Facility Information:

2.2.2.1 General Facility and System Description

Describe the function of the facility. Detail the overall dimensions of the facility, number of floors, foundation type, expected number of occupants, and facility Category Code. List and generally describe all the facility systems listed in the Primary Systems Information and any special building features (for example, HVAC Controls, Sprinkler Systems, Cranes, Elevators, and Generators). Include photographs marked up and labeled to show key operating components and the overall facility appearance.

2.2.2.2 Floor Plans

Provide uncluttered, legible 11 by 17 inches floor plans. Include room numbers, type or function of spaces, and overall facility dimensions on the floor plans. Do not include items such as construction instructions, references, or frame numbers.

2.2.2.3 Floor Coverings, Wall Surfaces, and Ceiling Surfaces

Provide a table that lists by room number (including hallways and common spaces), the type, and area of finish, manufacturer's product name, identifying number, and color. Include a facility summary of the total area for each type of space and floor, wall, or ceiling finish in the table.

2.2.2.4 Roofing

Provide the total area of each type of roof surface and system. Provide the name of the roofing product and system; manufacturer's, supplier's, and installer's names, addresses, and phone numbers; manufacturer's product name, identifying number, and color. For each type of roof, provide a recommended inspection, maintenance and repair schedule that details checkpoints, frequencies, and prohibited practices. List roof structural load limits.

2.2.2.5 HVAC Filters

Provide a table that lists the quantity, type, size, and location of each HVAC filter, manufacturer's product name, and identifying number.

2.2.2.6 Lighting Fixtures

Provide a table that lists by room number (including hallways and common spaces), the type of lighting fixture, ballast, number of lighting fixtures, type of lamps and number of lamps, and the manufacturer's product name and the identifying number. The table must include a facility summary of the total number of fixtures of each type and number of lamps of each type.

2.2.2.7 Equipment Listing

Provide a table that lists the major equipment shown on the design equipment schedules. Show the item descriptions, locations, model numbers; and the names, addresses, and telephone numbers of the manufacturers, suppliers, contractors, and subcontractors.

2.2.2.8 System Flow Diagrams

Provide a flow diagram indicating system liquid, air or gas flow during normal operations. Integrate all system components into the diagram. A compilation of non-integrated, flow diagrams for the individual system components are not acceptable.

2.2.2.9 Valve List

Provide a list of all valves associated with the system. Show valve type, identification number, function, location and normal operating position.

2.2.2.10 Riser Diagrams

Provide riser diagrams and settings of equipment.

2.3 eOMSI FACILITY DATA WORKBOOK

A pre-edited draft of the Model & Facility Data Matrix tab within the eOMSI Facility Data Workbook is attached to this section. The Government will provide this eOMSI Facility Data Workbook electronically to the Contractor upon award. Complete the KTR Facility Data File tab based on the selection of master systems, systems, and subsystems installed. The following tabs are included in the eOMSI Facility Data File Workbook and serve the purpose stated:

a. Instructions Tab: Instructions for completing Model & Facility Data Matrix Tab and KTR Facility Data File. If a discrepancy exists between

what is required in this section and the Workbook, the instructions within the workbook take precedence.

b. Model & Facility Data Matrix Tab: The Matrix lists Required Asset Fields for each SYSTEM and SUBSYSTEM. The Designer of Record selects SYSTEMS and SUBSYSTEMS that are within the project scope, which the Contractor needs to include and populate in KTR Facility Data File tab. The "Required Facility Asset Field Position Numbers," one through seventeen, are pre-populated, and are not editable.

c. Required Asset Fields Tab: Defines the 17 Required Facility Asset Field Position Numbers used in Model and Facility Data Matrix and KTR Facility Data File tabs.

d. KTR Sample Facility Data File Tab: Sample KTR eOMSI facility data file. This spreadsheet shows an example of the mandatory fields of all equipment to be included in the KTR eOMSI Facility Data File, along with their descriptions.

e. KTR Facility Data File Tab: Required eOMSI facility data file deliverable provided to the Government. Provide a separated and unique new row for each facility component or piece of equipment installed. Asset number will be provided at final by the Government.

PART 3 EXECUTION

3.1 FIELD VERIFICATION

Field verify eOMSI Facility Data Workbook information with Contractor and Government personnel. Include the following personnel in this meeting: Contractor's eOMSI Manual and Facility Data Workbook Preparer and Quality Control Manager, and the Government's Contracting Officer's Representative and NAVFAC PW FMD. Request, and provide, an eOMSI Field Verification Meeting no sooner than 14 calendar days after submission of the Progress eOMSI submittal, and another, no sooner than 14 calendar days after submission of the Prefinal eOMSI submittal. During this meeting, the Government and Contractor will verify that the eOMSI Facility Data Workbook is complete and accurate.

Field verify that at least 5 Subsystems under each of the Master Systems are accurate, for a total of 25 Subsystems. For each of these items, verify that the required facility asset field, as defined in the "Model & Facility Data Matrix" tab, contains the specified data and it is accurate (i.e. item description, manufacturer, model no., serial no.). 100 percent accuracy of eOMSI information is required for successful field verification. Any discrepancies discovered must be corrected prior to next eOMSI Facility Data Workbook Submittal.

(1) D10 - CONVEYING
(2) D20 - PLUMBING
(3) D30 - HVAC
(4) D40 - FIRE PROTECTION
(5) D50 - ELECTRICAL

3.2 eOMSI TRAINING

Prior to acceptance of the facility by the Contracting Officer for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The trainees must

include the Facilities Management Specialist, building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address all aspects of the eOMSI Manual and Facility Data Workbook submittal. Training must include classroom and field lectures as applicable. The location of classroom training requires approval by the Contracting Officer.

-- End of Section --

SECTION 02 41 00

DEMOLITION
05/10

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 within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2008) Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	(2006) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 2011) Safety and Health Requirements Manual

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

40 CFR 61	National Emission Standards for Hazardous Air Pollutants

1.2 PROJECT DESCRIPTION

1.2.1 Demolition/Deconstruction Plan

Prepare a Demolition Plan and submit proposed salvage, demolition, and removal procedures for approval before work is started. 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. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.2 General Requirements

Do not begin demolition until authorization is received from the

Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations. 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 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, or to be reused. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Ensure that structural elements are not overloaded. Do not overload structural elements and pavements to remain. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 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.

1.3.3 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.

1.3.4 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. 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.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Demolition Plan; G

Existing Conditions; G

SD-07 Certificates

Notification; G

1.6 QUALITY ASSURANCE

Submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the 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. 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. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.6.1 Dust and Debris Control

Prevent the spread of dust and debris 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.

1.7 PROTECTION

1.7.1 Traffic Control Signs

a. Where 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.

1.7.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished 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 elements 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.

1.8 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 shall 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. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

1.10 EXISTING CONDITIONS

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. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill voids, depressions or excavations resulting from demolition.

b. Fill material shall 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 shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

c. 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 onsite 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 onsite whenever possible.3.1.1 Structures

a. Remove existing structures indicated to be removed to top of foundation.

b. Demolish structures in a systematic manner from the top of the structure to the ground. Deconstruct 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, or framing.

d. Building, or the remaining portions thereof, to remain in place shall not be disturbed.

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 but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area.

3.1.3 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base to a depth of 6 inches below existing adjacent grade. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.4 Roofing

Remove roofing system without damaging the roof deck. Sequence work to minimize building exposure between demolition or deconstruction and new

roof materials installation.

3.1.5 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain 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 specified for the new work. Provide square, straight edges and corners where existing masonry adjoins new work and other locations..

3.1.6 Structural Steel

Dismantle structural steel at required locations and in a manner that will prevent bending or damage. Salvage for reuse structural steel, steel joists, girders, angles, plates, columns and shapes. 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 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.

3.1.7 Airfield Lighting

Remove existing airfield lighting as indicated and terminate in a manner satisfactory to the Contracting Officer. Remove edge lights, associated transformers as indicated and dispose of off station.

3.1.8 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.

3.1.9 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.

3.1.10 Electrical Equipment and Fixtures

Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.10.1 Fixtures

Remove and salvage electrical fixtures as indicated on drawings. 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.

3.1.10.2 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 as indicated on drawings. Box and tag these items for identification according to type and size.

3.2 DISPOSITION OF MATERIAL

3.2.1 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 materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, and removal procedures, and authorization by the Contracting Officer to begin demolition. 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.

3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.2.3 Salvaged Materials and Equipment

Remove materials and equipment that are 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 by the Contrating Officer.

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. On site sales of salvaged material is prohibited.

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.

d. 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.

3.3 CLEANUP

Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 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.

3.4.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.4.3 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.

3.5 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 03 30 00

CAST-IN-PLACE CONCRETE
01/08

PART 1 GENERAL

1.1 LUMP SUM CONTRACT

Under this type of contract, concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

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	(2009) Manual of Concrete Practice Part 1: ACI 104-71R-97 to 223-98
ACI/MCP-2	(2009) Manual of Concrete Practice Part 2 - ACI 224R-01 to ACI 313R-97
ACI/MCP-3	(2009) Manual of Concrete Practice Part 3 - ACI 315-99 to ACI 343R-95
ACI/MCP-4	(2009) Manual of Concrete Practice Part 4 - ACI 345R-05 to 355.2R-04

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

ASTM INTERNATIONAL (ASTM)

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 615/A 615M	(2009) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(2009) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(2009) 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 934/A 934M	(2007) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A 996/A 996M	(2009) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C 1240	(2005) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C 143/C 143M	(2009) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 156	(2005) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2008) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2009) 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	(2009a) 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 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 311	(2007) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 330	(2005) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2005e1e2) 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	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 595/C 595M	(2008a) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 920	(2010) 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	(2009) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2009a) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural

	Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 4397	(2009) 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 E 1155	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E 329	(2008) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 648	(2009a) 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)

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcing steel; G; AE

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;

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
Recycled Aggregate Materials
Cement
Portland Cement
Ready-Mix Concrete
Bonding Materials
Concrete Curing Materials
Reinforcement
Reinforcement Materials
Vapor barrier
Wood Forms
Form Release Agent (USDA)

Submit documentation indicating type of biobased material in product and biobased content.

SD-04 Samples

Waterstops

Three samples of each type waterstop, 1/2 inch long.

SD-05 Design Data

Concrete mix design; G; AE

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.

SD-06 Test Reports

Concrete mix design; G

Fly ash

Pozzolan

Ground granulated blast-furnace slag

Aggregates

Tolerance report

Compressive strength tests

Air Content

Slump

Air Entrainment

SD-08 Manufacturer's Instructions

Fly ash

Ground granulated blast-furnace slag

Submit mill certificates for Steel Bar according to the paragraph entitled, "Fabrication," of this section.

Provide certificates for concrete that are in accordance with the paragraph entitled, "Classification and Quality of Concrete," of this section. Provide certificates that contain project name and number, date, name of Contractor, name of concrete testing

service, source of concrete aggregates, material manufacturer, brand name of manufactured materials, material name, values as specified for each material, and test results. Provide certificates for Welder Qualifications that are in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

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.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Formwork CalculationsACI/MCP-4.

1.6.2 Drawings

1.6.2.1 Shop Drawings

Fabrication Drawings for Reinforcement Materials,
Floor Forms 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.

1.6.2.3 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

1.6.3.5 Form Removal Schedule

Submit schedule for form removal indicating element and minimum length of time for form removal.

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

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer.

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.

1.11 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/C 33M.

Sample and test portland cement in accordance with ASTM C 150/C 150M.

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

2.1.1 Wood Forms

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.

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.

2.2 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.

2.3 CONCRETE

2.3.2 Contractor-Furnished Mix Design

ACI/MCP-1, ACI/MCP-2, and ACI/MCP-3 except as otherwise specified. Indicate the compressive strength (f'c) of the concrete for each portion of the structure(s) and as specified below.

Location	f'c (Min. 28-Day Comp. Strength) (psi)	ASTM C 33/C 33M Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water-Cement Ratio (by weight)	Air Entr. (percent)
Concrete exposed to weather	4000	57	4+-1	0.45	5.5%
Floor slabs	4000	57	4+-1	0.45	(a)
Elevated Floor Slabs	3000	57	4+-1	0.45	(a)

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. Note (a): Entrapped air must be 3% or less.

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; 110 pcf (dry) for floors with a 3000 psi minimum compressive strength at 28 days.

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

Concrete is an EPA-designated product for recycled content. Incorporate fly-ash slag and or silica fume to the extent practical, meeting the other requirements of this Section, in accordance with Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIAL

2.4.1 Cement

ASTM C 150/C 150M, Type I or II or ASTM C 595/C 595M blended cement except as modified herein. Provide blended cement that consists of a mixture of ASTM C 150/C 150M, 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. 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 20 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 120.

2.4.1.3 Silica Fume
ASTM C 1240

2.4.1.4 Portland Cement

Provide cement that conforms to ASTM C 150/C 150M, Type I oe II. 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 free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

ASTM C 33/C 33M, 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.

2.4.3.3 Recycled Aggregate Materials

Submit recycled material request with the aggregate certification submittals and do not use until approved by the Contracting Officer.

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.

2.4.5.3 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C 618.

2.4.6 Vapor Barrier

ASTM D 4397 polyethylene sheeting, minimum 10 mil thickness.

2.4.7 Materials for Curing Concrete

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 nonbituminous type filler strips conforming to ASTM D 1752, Type I or II.

2.4.10 Joint Sealants

2.4.10.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 1190 or ASTM C 920, Type M, Class 25, Use T.

2.4.10.3 Waterstops

Provide waterstops that are pre-formed, non-expansive, self-sealing, plastic adhesive waterstop. To be Synko-flex type material.

Provide waterstops made of rubber and that conform to ASTM D 1752.

2.4.10.4 Joint Sealant Compound

Provide hot-poured, elastic type compound conforming to ASTM D 1190.

2.4.12 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and

water-based, with a low (maximum of 55 grams/liter (g/l))VOC content. 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. ASTM A 996/A 996M with the bars marked A, Grade 60.

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.

2.5.3 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 flat sheets of welded wire fabric for slabs and toppings.

2.5.4 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material.

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.

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.

3.2.4 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.

3.3.5 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 spill 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.

3.3.10 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

Strip waterstops: Install in construction joints and at other locations indicated according to manufacturer's instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths possible.

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. 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.

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.

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. 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, ASTM A 934/A 934M and 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.

3.8.5 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.

3.8.6 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.

3.9.3.3 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.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided. 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

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.

3.10.1.4 Steel Troweled

Use for floors intended as walking surfaces, and for reception of floor coverings. 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.

3.10.1.6 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.

3.10.2 Flat Floor Finishes

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.

3.11 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.

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

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.

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 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.

3.12.2.7 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.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.

3.14.3 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.

-- End of Section --

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE FOR BUILDING STRUCTURES
05/14

PART 1 GENERAL

1.1 SUMMARY

Perform all work in accordance with ACI 318.

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 CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	(2010; Errata 2011) Specifications for Structural Concrete
ACI 302.1R	(2004; Errata 2006; Errata 2007) Guide for Concrete Floor and Slab Construction
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306R	(2010) Guide to Cold Weather Concreting
ACI 318	(2014; Errata 2014) Building Code Requirements for Structural Concrete and Commentary
ACI 347	(2004; Errata 2008; Errata 2012) Guide to Formwork for Concrete
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2014) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A615/A615M	(2014) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C1064/C1064M	(2011) Standard Test Method for

	Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C143/C143M	(2012) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2014a) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2014a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C494/C494M	(2013) Standard Specification for Chemical Admixtures for Concrete
ASTM C685/C685M	(2011) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2014b) Standard Specification for Ready-Mixed Concrete
ASTM D75/D75M	(2014) Standard Practice for Sampling

	Aggregates
ASTM D98	(2005; R 2013) Calcium Chloride
ASTM E1155	(2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E1155M	(2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers (Metric)
ASTM E1643	(2011) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	(2011) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E96/E96M	(2013) Standard Test Methods for Water Vapor Transmission of Materials

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

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Air-Entraining Admixture
Accelerating Admixture
Water-Reducing or Retarding Admixture
Curing Materials
Joint Sealants
Chemical Floor Hardener
Mix Design Data; G
Ready-Mix Concrete
Burlap Backed Polyethylene Sheet Moisture Retaining Cover Curing Material
Mechanical Reinforcing Bar Connectors

SD-06 Test Reports

Aggregates
Concrete Mixture Proportions; G
Measurement of Floor Tolerances

Compressive Strength Testing; G
Slump; G
Air Content
Water

SD-07 Certificates

Cementitious Materials
Pozzolan
Aggregates
Delivery Tickets

SD-08 Manufacturer's Instructions

Chemical Floor Hardener
Curing Compound

1.4 QUALITY ASSURANCE

Indicate specific locations of Concrete Placement Forms Steel Reinforcement Accessories Expansion Joints Construction Joints Contraction Joints Control Joints on installation drawings and include, but not be limited to, square feet of concrete placements, thicknesses and widths, plan dimensions, and arrangement of cast-in-place concrete section.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The Government retains the option to sample and test joint sealer, joint filler material, aggregates and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Obtain samples of aggregates at the point of batching in accordance with ASTM D75/D75M. Sample concrete in accordance with ASTM C172/C172M. Determine slump and air content in accordance with ASTM C143/C143M and ASTM C231/C231M, respectively, when cylinders are molded. Prepare, cure, and transport compression test specimens in accordance with ASTM C31/C31M. Test compression test specimens in accordance with ASTM C39/C39M. Take samples for strength tests not less than once each shift in which concrete is produced from each strength of concrete required. Provide a minimum of six specimens from each sample; three to be tested at 28 days for acceptance, two will be tested at 7 days for information and one held in reserve.

2.1.1 Strength

Acceptance test results are the average strengths of three specimens tested at 28 days. The strength of the concrete is considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, f'c, but not more than 20 percent, and no individual acceptance test result falls below f'c by more than 500 psi.

2.1.2 Construction Tolerances

Apply a Class "A" finish to all surfaces except those which will be permanently concealed. Surface requirements for the classes of finish required are as specified in ACI 117.

2.1.3 Concrete Mixture Proportions

Concrete mixture proportions are the responsibility of the Contractor. Mixture proportions must include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per yard of concrete. Provide materials included in the mixture proportions of the same type and from the same source as will be used on the project. The specified compressive strength f'c is 4,000 psi at 28 days. The maximum nominal size coarse aggregate is 1-1/2 inch, in accordance with ACI 304R. The air content must be between 4.5 and 7.5 percent with a slump between 2 and 5 inches. The maximum water-cementitious material ratio is 0.42. Submit the applicable test reports and mixture proportions that will produce concrete of the quality required, ten days prior to placement of concrete.

2.2 MATERIALS

Submit manufacturer's literature from suppliers which demonstrates compliance with applicable specifications for the specified materials.

2.2.1 Cementitious Materials

Submit Manufacturer's certificates of compliance, accompanied by mill test reports, attesting that the concrete materials meet the requirements of the specifications in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Also, certificates for all material conforming to EPA's Comprehensive Procurement Guidelines (CPG), in accordance with 40 CFR 247. Provide cementitious materials that conform to the appropriate specifications listed:

2.2.1.1 Portland Cement

ASTM C150/C150M, Type II, low alkali with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na2Oe (sodium oxide) equivalent.

2.2.2 Aggregates

For fine and coarse aggregates meet the quality and grading requirements of ASTM C33/C33M and test and evaluate for alkali-aggregate reactivity in accordance with ASTM C1260. Perform evaluation of fine and coarse aggregates separately and in combination, matching the proposed mix design proportioning. All results of the separate and combination testing must have a measured expansion less than 0.08 percent at 28 days after casting. If the test data indicates an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1260 and ASTM C1567. Perform the additional testing using ASTM C1260 and ASTM C1567 using the low alkali portland cement in combination with ground granulated blast furnace (GGBF) slag, or Class F fly ash. Use GGBF slag in the range of 40 to 50 percent of the total cementitious material by mass. Use Class F fly ash in the range of 15 to 20 percent of the total cementitious material by mass. Submit certificates of compliance and test reports for aggregates showing the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

2.2.3 Admixtures

Provide admixtures, when required or approved, in compliance with the appropriate specification listed. Retest chemical admixtures that have been in storage at the project site, for longer than 6 months or that have been subjected to freezing, at the expense of the Contractor at the request of the Contracting Officer and will be rejected if test results are not satisfactory.

2.2.3.1 Air-Entraining Admixture

Provide air-entraining admixture that meets the requirements of ASTM C260/C260M.

2.2.3.2 Accelerating Admixture

Provide calcium chloride meeting the requirements of ASTM D98. Other accelerators must meet the requirements of ASTM C494/C494M, Type C or E.

2.2.3.3 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of ASTM C494/C494M, Type A, B, or D.

2.2.4 Water

Mixing and curing water in compliance with the requirements of ASTM C1602/C1602M; potable, and free of injurious amounts of oil, acid, salt, or alkali. Submit test report showing water complies with ASTM C1602/C1602M.

2.2.5 Reinforcing Steel

Provide reinforcing bars conforming to the requirements of ASTM A615/A615M, Grade 60, deformed. Provide welded steel wire reinforcement conforming to the requirements of ASTM A1064/A1064M. Detail reinforcement not indicated in accordance with ACI 301 and ACI SP-66. Provide mechanical reinforcing bar connectors in accordance with ACI 301 and provide 125 percent minimum yield strength of the reinforcement bar.

2.2.6 Joint Sealants - Field Molded Sealants

Conform to ASTM C920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Provide polyethylene tape, coated paper, metal foil, or similar type bond breaker materials. The backup material needs to be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, clean the joint of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

2.2.7 Formwork

Design and engineer the formwork as well as its construction in accordance with ACI 301 Section 2 and 5 and ACI 347. Fabricate of wood, steel, or other approved material. Submit formwork design prior to the first concrete placement.

2.2.8 Form Coatings

Provide form coating in accordance with ACI 301.

2.2.9 Vapor Retarder

ASTM E1745 Class A polyethylene sheeting, minimum 10 mil thickness or other equivalent material with a maximum permeance rating of 0.03 perms per ASTM E96/E96M.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.2.10 Curing Materials

Provide Mositure Retaining Cover curing materials in accordance with ACI 301, Section 5.

2.3 READY-MIX CONCRETE

Provide ready-mix concrete with mix design data conforming to ACI 301 Part 2. Submit delivery tickets in accordance with ASTM C94/C94M for each ready-mix concrete delivery, include the following additional information: .

a. Type and brand cement

b. Cement content in 94-pound bags per cubic yard of concrete

c. Maximum size of aggregate

d. Amount and brand name of admixture

e. Total water content expressed by water cementitious material ratio

2.4 ACCESSORIES

2.4.1 Chemical Floor Hardener

Provide hardener which is a colorless aqueous solution containing a blend of inorganic silicate or siliconate material and proprietary components combined with a wetting agent; that penetrates, hardens, and densifies concrete surfaces. Submit manufactures instructions for placement of liquid chemical floor hardener.

PART 3 EXECUTION

3.1 PREPARATION

Prepare construction joints to expose coarse aggregate. The surface must be clean, damp, and free of laitance. Construct ramps and walkways, as necessary, to allow safe and expeditious access for concrete and workmen. Remove snow, ice, standing or flowing water, loose particles, debris, and foreign matter. Satisfactorily compact earth foundations. Make spare vibrators available. Placement cannot begin until the entire preparation has been accepted by the Government.

3.1.1 Embedded Items

Secure reinforcement in place after joints, anchors, and other embedded

items have been positioned. Arrange internal ties so that when the forms are removed the metal part of the tie is not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Prepare embedded items so they are be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete is permitted only when specifically authorized or directed. Provide all equipment needed to place, consolidate, protect, and cure the concrete at the placement site and in good operating condition.

3.1.2 Formwork Installation

Forms must be properly aligned, adequately supported, and mortar-tight. Provide smooth form surfaces, free from irregularities, dents, sags, or holes when used for permanently exposed faces. Chamfer all exposed joints and edges , unless otherwise indicated.

3.1.3 Vapor Retarder Installation

Install in accordance with ASTM E1643. Apply vapor retarder over compacted fine aggregate material as indicated. Lap edges not less than 12 inches. Seal all joints with pressure-sensitive adhesive not less than 2 inches wide. Protect the vapor retarder at all times to prevent injury or displacement prior to and during concrete placement. Seal around all penetrations with pipe/conduit boots in accordance with vapor retarder manufacturers written instructions.

3.1.4 Production of Concrete

3.1.4.1 Ready-Mixed Concrete

Provide ready-mixed concrete conforming to ASTM C94/C94M except as otherwise specified.

3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing

Conform to ASTM C685/C685M.

3.2 CONVEYING AND PLACING CONCRETE

Convey and place concrete in accordance with ACI 301, Section 5.

3.2.1 Cold-Weather Requirements

Place concrete in cold weather in accordance with ACI 306R

3.2.2 Hot-Weather Requirements

Place concrete in hot weather in accordance with ACI 305R

3.3 FINISHING

3.3.1 Temperature Requirement

Do not finish or repair concrete when either the concrete or the ambient temperature is below 50 degrees F.

3.3.2 Finishing Formed Surfaces

Remove all fins and loose materials , and surface defects including filling of tie holes. Repair all honeycomb areas and other defects. Remove all unsound concrete from areas to be repaired. Ream or chip surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete and fill with dry-pack mortar. Brush-coat the prepared area with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filling with mortar or concrete. Use a blend of portland cement and white cement in mortar or concrete for repairs to all surfaces permanently exposed to view shall be so that the final color when cured is the same as adjacent concrete.

3.3.3 Finishing Unformed Surfaces

Finish unformed surfaces in accordance with ACI 301.

3.3.3.1 Flat Floor Finishes

In accordance with ACI 302.1R, construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite FF/FL Values for Various Construction Methods." ACI 117 for tolerances tested by ASTM E1155M or ASTM E1155. These requirements are based upon the latest FF/FL method.

3.3.3.1.1 Floor Slabs

Conform floor slabs on grade to the following ACI F-number requirements unless noted otherwise:

Specified Overall Values	FF30/FL23 minimum
Minimum Local Values	FF17/FL15 minimum

3.3.3.2 Measurement of Floor Tolerances

Test floor slabs within 24 hours of the final troweling. Submit test results to Contracting Officer within 12 hours after collecting data. Floor flatness inspector mustl provide a tolerance report which includes:

a. Name of Project

b. Name of Contractor

c. Date of Data Collection

d. Date of Tolerance Report

e. A Key Plan Showing Location of Data Collected

f. Results Required by ASTM E1155M ASTM E1155

3.3.3.3 Expansion and Contraction Joints

Make expansion and contraction joints in accordance with the details shown or as otherwise specified. Provide 1/2 inch thick transverse expansion joints where new work abuts an existing concrete.

3.4 CURING AND PROTECTION

Cure and protect with Moisture Retaining Cover type curing materials in accordance with ACI 301, Section 5.

3.5 FORM WORK

Provide form work in accordance with ACI 301, Section 2 and Section 5.

3.5.1 Removal of Forms

Remove forms in accordance with ACI 301, Section 2.

3.6 STEEL REINFORCING

Reinforcement must be free from loose, flaky rust and scale, and free from oil, grease, or other coating which might destroy or reduce the reinforcement's bond with the concrete.

3.6.1 Fabrication

Shop fabricate steel reinforcement in accordance with ACI 318 and ACI SP-66. Provide shop details and bending in accordance with ACI 318 and ACI SP-66.

3.6.2 Splicing

Perform splices in accordance with ACI 318 and ACI SP-66.

3.6.3 Supports

Secure reinforcement in place by the use of metal or concrete supports, spacers, or ties.

3.7 EMBEDDED ITEMS

Before placing concrete, take care to determine that all embedded items are firmly and securely fastened in place. Provide embedded items free of oil and other foreign matter, such as loose coatings of rust, paint and scale. Embedding of wood in concrete is permitted only when specifically authorized or directed.

3.8 CHEMICAL FLOOR HARDENER

Apply Chemical Floor Hardener, after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats. First coat is one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow it to dry 24 hours before applying next coat. Apply proprietary chemical hardeners in accordance with manufacturer's printed directions.

3.9 TESTING AND INSPECTING

Report the results of all tests and inspections conducted at the project site informally at the end of each shift. Submit written reports weekly. Deliver within three days after the end of each weekly reporting period. See Section 01 45 00.00 10 QUALITY CONTROL.

3.9.1 Field Testing Technicians

The individuals who sample and test concrete must have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

3.9.2 Preparations for Placing

Inspect foundation or construction joints, forms, and embedded items in sufficient time prior to each concrete placement to certify that it is ready to receive concrete.

3.9.3 Sampling and Testing

a. Obtain samples and test concrete for quality control during placement. Sample fresh concrete for testing in accordance with ASTM C172/C172M. Make six test cylinders.

b. Test concrete for compressive strength at 7 and 28 days for each design mix and for every 50 cubic yards of concrete. Test two cylinders at 7 days; three cylinders at 28 days; and hold one cylinder in reserve. Conform test specimens to ASTM C31/C31M. Perform compressive strength testing conforming to ASTM C39/C39M.

c. Test slump at the plant site of discharge for each design mix in accordance with ASTM C143/C143M. Check slump twice during each shift that concrete is produced for each strength of concrete required.

d. Test air content for air-entrained concrete in accordance with ASTM C231/C231M. Test concrete using lightweight or extremely porous aggregates in accordance with ASTM C173/C173M. Check air content at least once during each shift that concrete is placed for each strength of concrete required.

e. Determine temperature of concrete at time of placement in accordance with ASTM C1064/C1064M. Check concrete temperature at least once during each shift that concrete is placed for each strength of concrete required.

3.9.4 Action Required

3.9.4.1 Placing

Do not begin placement until the availability of an adequate number of acceptable vibrators, which are in working order and have competent operators, has been verified. Discontinue placing if any lift is inadequately consolidated.

3.9.4.2 Air Content

Whenever an air content test result is outside the specification limits, adjust the dosage of the air-entrainment admixture prior to delivery of concrete to forms.

3.9.4.3 Slump

Whenever a slump test result is outside the specification limits, adjust the batch weights of water and fine aggregate prior to delivery of concrete

to the forms. Make the adjustments so that the water-cementitious material ratio does not exceed that specified in the submitted concrete mixture proportion and the required concrete strength is still met.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL
05/14

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 201	(2006) AISC Certification Program for Structural Steel Fabricators
AISC 303	(2010) Code of Standard Practice for Steel Buildings and Bridges
AISC 325	(2011) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 341	(2010) Seismic Provisions for Structural Steel Buildings
AISC 360	(2010) Specification for Structural Steel Buildings
AISC DESIGN GUIDE 10	(1997) Erection Bracing of Low-Rise Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(2009) Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	(2010; E 2013) Standard Specification for

	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A490	(2012) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A500/A500M	(2013) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	(2007a; R2014) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A6/A6M	(2014) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2011) Standard Specification for Structural Steel Shapes
ASTM C1107/C1107M	(2014) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C827/C827M	(2010) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F1554	(2007a; E 2011) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1852	(2011) Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM F2329	(2013) Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F436	(2011) Hardened Steel Washers

ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC Paint 20	(2002; E 2004) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 29	(2002; E 2004) Zinc Dust Sacrificial Primer, Performance-Based
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2013) Structural Engineering
UFC 3-310-04	(2013) Seismic Design for Buildings

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Erection Drawings; G

SD-02 Shop Drawings

Fabrication drawings including description of connections; G

SD-03 Product Data

Shop primer

Welding electrodes and rods

Non-Shrink Grout

Tension control bolts

SD-06 Test Reports

Bolts, nuts, and washers

Weld Inspection Reports

Bolt Testing Reports

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

Welding procedures and qualifications

Welding electrodes and rods

1.3 QUALITY ASSURANCE

1.3.1 Preconstruction Submittals

1.3.1.1 Erection Drawings

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing. The erection drawings must conform to AISC 303. Erection drawings must be reviewed, stamped and sealed by a registered professional engineer.

1.3.2 Fabrication Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings must not be reproductions of contract drawings. 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. Any deviations from the details shown on the contract drawings must be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.3.3 Certifications

1.3.3.1 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 must 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 SYSTEM DESCRIPTION

Provide the structural steel system complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing must be provided in accordance with AISC 360, AISC 341, UFC 3-301-01 and UFC 3-310-04 except as modified in this contract.

2.2 STEEL

2.2.1 Structural Steel

Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M.

2.2.2 Structural Steel Tubing

ASTM A500/A500M, Grade B.

2.2.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard).

2.3 BOLTS, NUTS, AND WASHERS

Submit 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.

2.3.1 Common Grade Bolts

2.3.1.1 Bolts

ASTM A307, Grade A. 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.

2.3.1.2 Nuts

ASTM A563M, Grade A, heavy hex style.

2.3.1.3 Self-Locking Nuts

Provide nuts with a locking pin set in the nut. The locking pin must slide along the bolt threads, and by reversing the direction of the locking pin, the nut must be removed without damaging the nut or bolt. Provide stainless steel locking pins.

2.3.1.4 Washers

ASTM F844.

2.3.2 High-Strength Bolts

2.3.2.1 Bolts

ASTM A325, Type 1 ASTM A490, Type 1 or 2.

2.3.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.3.2.3 Washers

ASTM F436, plain carbon steel.

2.3.3 Tension Control Bolts

ASTM F1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon steel nuts, and hardened carbon steel washers. Assembly finish must be mechanically deposited zinc coating.

2.3.4 Foundation Anchorage

2.3.4.1 Anchor Rods

ASTM F1554 Gr 36, Class 1A.

2.3.4.2 Anchor Nuts

ASTM A563, Grade A, hex style.

2.3.4.3 Anchor Washers

ASTM F844.

2.3.4.4 Anchor Plate Washers

ASTM A36/A36M

2.4 STRUCTURAL STEEL ACCESSORIES

2.4.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.4.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout must be nonmetallic.

2.5 GALVANIZING

ASTM F2329 for threaded parts or ASTM A123/A123M for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in ASTM A6/A6M.

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.

2.6.1 Markings

Prior to erection, members must be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

2.6.2 Shop Primer

SSPC Paint 20 or SSPC Paint 29, (zinc rich 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 epoxy coatings, 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). If flash rusting occurs, re-clean the surface prior to application of primer. Apply primer in accordance with endorsement "P1" of AISC 201 to a minimum dry film thickness of 2.0 mil.

Slip critical surfaces must be primed with a Class B coating in accordance with AISC 325. Submit test report for 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. Repair damaged primed surfaces with an additional coat of primer.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, 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.

2.7 DRAINAGE HOLES

Adequate drainage holes must be drilled to eliminate water traps. Hole diameter must be 1/2 inch and location must be indicated on the detail drawings. Hole size and location must not affect the structural integrity.

PART 3 EXECUTION

3.1 ERECTION

a. Erection of structural steel, except as indicated in item b. below, must be in accordance with the applicable provisions of AISC 325.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the structure must be erected in accordance with AISC DESIGN GUIDE 10.

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.

3.1.1 STORAGE

Material must be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.2 CONNECTIONS

Except as modified in this section, connections not detailed must be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

ASTM A307 bolts must 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.

3.2.2 High-Strength Bolts

Provide direct tension indicator washers in all ASTM A325 and ASTM A490 bolted connections. Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts must then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.2.2.1 Installation of Direct Tension Indicator Washers (DTIW)

Where possible, the DTIW must be installed under the bolt head and the nut must be tightened. If the DTIW is installed adjacent to the turned element, provide a flat washer between the DTIW and nut when the nut is turned for tightening, and between the DTIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat washers under both the bolt head and nut when ASTM A490 bolts are used.

3.2.3 Tension Control Bolts

Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts must then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.3 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 Officer.

3.4 WELDING

Welding must be in accordance with AWS D1.1/D1.1M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

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 must be submitted for approval.

3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Removal is not required.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Steel exposed to the weather, or located in building areas without HVAC for control of relative humidity must be field primed. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat must be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Contracting Officer must be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.

3.7.1 Welds

3.7.1.1 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.

Inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use.

3.7.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with AWS D1.1/D1.1M. Test locations if neeed must be selected by the Contracting Officer. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder must be tested by ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing must be used only in areas inaccessible to ultrasonic testing. Retest defective areas after repair. Submit weld inspection reports.

Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Ultrasonic	3
Magnetic Particle	0
Dye Penetrant	0

3.7.2 High-Strength Bolts

3.7.2.1 Inspection

Inspection procedures must be in accordance with AISC 360. 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.

Inspect calibration of torque wrenches for high-strength bolts.

3.7.2.2 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

-- 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/B2.1M	(2014) Specification for Welding Procedure and Performance Qualification
AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 15	(1999; E 2004) Steel Joist Shop Primer

STEEL JOIST INSTITUTE (SJI)

SJI LOAD TABLES	(2005; Errata 1 2006; Errata 2 2007; Errata 3 2007) 42nd Edition Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders
SJI MANUAL	(2009) 80 Years of Open Web Steel Joist Construction

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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 29 CFR 1910.1200

SD-02 Shop Drawings

Steel joist framing; G

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/B2.1M, 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
29 CFR 1926

PART 2 PRODUCTS

2.1 JOISTS AND ACCESSORIES

Provide design data from SJI LOAD TABLES for the joist series indicated.

2.2 PAINTING

2.2.1 Shop Painting

Clean and prime joists in accordance with SSPC Paint 15. 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 LOAD TABLES for the joist series indicated.

3.1.2 Welding

All welding must conform to AWS B2.1/B2.1M 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 concrete grout must be as specified in Section 04 20 00 MASONRY and Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE FOR BUILDING STRUCTURES.

3.3 PAINTING

3.3.1 Touch-Up Painting

After erection of joists, 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 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 --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 05 30 00

STEEL DECKS
11/11

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 IRON AND STEEL INSTITUTE (AISI)

AISI D100	(1991; R 2008) Cold-Formed Steel Design Manual
AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel
AWS D1.3/D1.3M	(2008; Errata 2008) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2013) 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 A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	(2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM D1056	(2014) Standard Specification for Flexible

	Cellular Materials - Sponge or Expanded Rubber
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D746	(2013) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM DS 1-28	(2002) Design Wind Loads

STEEL DECK INSTITUTE (SDI)

SDI DDMO3	(2004; Errata 2006; Add 2006) Diaphragm Design Manual; 3rd Edition
SDI DDP	(1987; R 2000) Deck Damage and Penetrations
SDI MOC2	(2006) Manual of Construction with Steel Deck

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2013) Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL 209	(2011) Cellular Metal Floor Raceways and Fittings
UL 580	(2006; Reprint Oct 2013) Tests for Uplift Resistance of Roof Assemblies

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G

Cant Strips; G

Ridge Plates; G

Metal Closure Strips; G

SD-03 Product Data

Accessories; G

Deck Units; G

Galvanizing Repair Paint; G

Joint Sealant Material; G

Repair Paint; G

Welder Qualifications; G

Welding Equipment; G

Welding Rods and Accessories; G

SD-04 Samples

Metal Roof Deck Units; G

Flexible Closure Strips; G

Accessories; G

SD-05 Design Data

Deck Units; G

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 manufacturer's certificates attesting that the decking material meets the specified requirements.

1.3.2 Certification of Powder-Actuated Tool Operator

Manufacturer's certificate attesting that the operators are authorized to use the low velocity powder-actuated 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 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 3-301-01.

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. The maximum uniform distributed storage load must not exceed the design live 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 D100.

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 A653/A653M designation G90 galvanized, or ASTM A792/A792M 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 A780/A780M.

2.1.4 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A36/A36M, merchant quality, Grade Designation SAE/AISI 1023 or SAE/AISI 1025, and hot-dip galvanized in accordance with ASTM A123/A123M.

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 A780/A780M.

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 D1056, Grade No. SCE 41, with the following additional properties:

Brittleness temperature of minus 40 degrees F when tested in accordance with ASTM D746.

Flammability resistance with a flame spread rating of less than 25 when tested in accordance with ASTM E84.

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 D1149.

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 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.028 inch thick to close open ends at eaves and openings through deck.

2.2.3 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.

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 Roof Sump Pans

Sump pans must be provided for roof drains and must be minimum 0.075 inch thick steel, flat or recessed type as indicated. 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.

2.2.6 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.7 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.8 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 plates.

2.3 FABRICATION

2.3.1 Roof Deck

Conform to ASTM A792/A792M or ASTM A1008/A1008M for deck used in conjunction with insulation and built-up roofing. Fabricate roof deck units of the steel design thickness required by the design drawings and zinc-coated in conformance with ASTM A653/A653M, G90 coating class or aluminum-zinc coated in accordance with ASTM A792/A792M Coating Designation AZ55.

2.3.1.1 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.

2.3.1.2 Ridge 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.

2.3.1.3 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.

2.3.2 Touch-Up Paint

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 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. Do not use unanchored deck units as a work or storage platform. 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.

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 as indicated on the design drawings and in accordance with manufacturer's recommended procedure. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding. 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. Conform to the recommendations of the Steel Deck Institute and the steel deck manufacturerfor location, size, and spacing of fastening. Do not 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 butted deck ends. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDMO3. 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 A780/A780M.

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

Provide in locations too narrow to accommodate full-size deck units and 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.

3.2.4.4 Access Hole Covers

Provide access whole covers to seal holes cut in decking to facilitate welding of the deck to structural supports.

3.2.4.5 Hangers

Do not attach any hangers to the roof deck.

3.3 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.

3.4 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.

3.5 RIDGE PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inch.

3.6 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.

3.7 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.

3.8 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.9 FIELD QUALITY CONTROL

3.9.1 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks, 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 06 13 33

PIER TIMBERWORK
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 PROTECTION ASSOCIATION (AWPA)

AWPA M4	(2011) Standard for the Care of Preservative-Treated Wood Products
AWPA M6	(2013) Brands Used on Preservative Treated Materials

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A276	(2013) Standard Specification for Stainless Steel Bars and Shapes
ASTM F593	(2013) Stainless Steel Bolts, Hex Cap Screws, and Studs

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-P-21035	(1991; Rev B; Notice 2 2003) Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit all inclusive unit costs (add/deduct values) for the repair of each damaged or deteriorated pile using the epoxy repair with fiber reinforced wrap identified by the project structural drawings. This information shall be included as part of bid documents for inclusion with project submittals by the successful bidder.

SD-02 Shop Drawings

Pier timberwork

Submit drawings of treated timber showing dimensions of cut, framed, or bored timbers. Show location, size, and material properties for all connections including bolt assemblies, plates, angles, and miscellaneous components. Submit Manufacturer's data and installation directions for Copper Naphthenate material for treating over-drilled existing bolt holes and cut ends, notches, damaged areas, etc. for treated wood members.

Submit manufacturer's data and installation direction for Creosote material for treating cut ends, damaged areas, exposed surfaces, etc., and for repairing and replenishing worn or damaged areas of the piles. Submit manufacturer's data and installation directions for black flat topped PVC Protective Pile Caps.

Submit a pile repair plan that lists each pile and the specific coatings, repair materials, and procedures for each pile.

SD-03 Product Data

Submit product data for copper naphthenate material, creosote material, Type 316 stainless steel connectors, timber preservative, epoxy repair with fiber reinforced wrap for piles and black flat topped PVC protective pile caps.

SD-04 Samples

Submit samples for Type 316 stainless steel connections, epoxy and fiber reinforced wrap pile repair materials and black PVC protective pile caps.

SD-06 Test Reports

Submit pile inspection reports in accordance with UFC 4-150-07, Maintenance of Waterfront Facilities.

Timber preservative inspection

Delivery inspection list

SD-07 Certificates

MSDS and CIS

Submit certificates, MSDS, and CIS for timber material and structural properties, pressure-treatment and creosote materials, pile repair materials, PVC pile protective caps.

1.3 DELIVERY AND STORAGE

Open-stack timber and lumber material on skids at least 12 inches aboveground, in a manner that will prevent warping and allow shedding of water. Close-stack treated timber and lumber material in a manner that will prevent long timbers or preframed material from sagging or becoming crooked. Keep ground under and within 5 feet of such piles free of weeds,

rubbish, and combustible materials. Protect materials from weather. Handle treated timber with ropes or chain slings without dropping, breaking outer fibers, bruising, or penetrating surface with tools. Do not use cant dogs, peaveys, hooks, or pike poles. Protect timber and hardware from damage.

1.4 QUALITY ASSURANCE

1.4.1 MSDS and CIS

Provide Material Safety Data Sheets (MSDS) and Consumer Information Sheets (CIS) associated with timber pile preservative pressure-treatment and creosote. Contractor shall comply with all safety precautions indicated on MSDS and CIS.

1.4.2 Timber Preservative Inspection

Submit the inspection report of an independent inspection agency, for approval by the Contracting Officer, that offered products complying with applicable AWPA Standards. Identify treatment on each piece by the quality mark of an agency accredited by the Board of Review of the American Lumber Standard Committee.

1.4.3 Delivery Inspection List

Field inspect and submit a verification list of each treated timber member and each strapped bundle of treated lumber indicating the wording and lettering of the quality control markings, the species and the condition of the wood. Do not incorporate materials damaged in transport from plant to site. Inspect all preservative-treated wood, visually to ensure there are no excessive residual materials or preservative deposits. Material shall be clean and dry or it will be rejected due to environmental concerns.

1.4.4 Preservative Applications

Provide certifications for all individuals (applicators) who will be working with wood preservatives on site. All applicators shall be certified by the State of Texas or Environmental Protection Agency (EPA) to use wood preservatives and have completed an applicable approved training program on the use of wood preservatives in accordance with AWPA M4.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Lumber and Timbers

2.1.1.1 Solid Sawn

Provide solid sawn pressure-treated lumber and timbers of stress-rated Southern Pine, with a stress rating as indicated, and identified by the grade mark of a recognized association or independent inspection agency using the specific grading requirements of an association recognized as covering the species used. The association or independent inspection agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Use stress rated lumber and timbers for secondary members such as decking, joists and railings.

2.1.1.2 Preservative Treatment

All wood products shall be pressure-treated and labeled with American Wood Protection Association's (AWPA) Use Category UC4B using Chromated Copper Arsenate (CCA) with a minimum net preservative retention of 0.6 pcf. All wood products in direct contact with the ground or located within the tidal range shall be pressure-treated and labeled with AWPA Use Category UC5C using CCA with a minimum net preservative retention of 2.5 pcf.

Fabricate lumber and timbers before preservative treatment. Each piece of treated lumber or timber shall be branded, by the producer, in accordance with AWPA M6. Alternate preservatives including chromated zinc chlorides, pentachlorophenol-ammoniacal systems, and alkyl ammonium compounds will not be allowed. Coat cuts, notches, damaged areas of pressure-treated lumber and timbers located above the splash zone and tidal zone with copper naphthenate in accordance with AWPA M4-08. Coat bolt holes, cuts, notches, over-drilled holes and damaged areas of lumber , timbers and piles located in the splash zone and tidal zone with copper naphthenate followed by creosote in accordance with AWPA M4-08 prior to connecting members and installing new bolts. The Contractor shall be responsible for the quality of treated wood products.

2.1.2 Hardware

All bolts shall have all necessary nuts and washers, timber connectors, nails, screws, spikes, and other fastenings. All bolts, nuts, and other connection elements shall be Type 316 Stainless Steel in accordance with ASTM F593. Provide Type 316 Stainless Steel ogee washers, or plate washers where indicated. Provide bolts with washers under nut and head. Provide timber connectors and other metal fastenings of type and size shown. Hot-dip galvanize connections will not be acceptable. All plates, angles, and shapes indicated shall be Type 316 Stainless Steel in accordance with ASTM A276.

2.1.2.1 Zinc-Coating

Galvanize steel where specified or indicated by the hot-dip process in accordance with ASTM A123/A123M or ASTM A153/A153M, as applicable.

PART 3 EXECUTION

3.1 CONSTRUCTION

Cut, bevel, and face timbers prior to plant preservative treatment. In addition to the contract clause entitled "Accident Prevention" provide protective equipment for personnel fabricating, field treating, or handling materials treated with chromated copper arsenate, copper naphthenate, or creosote. Refer to paragraph entitled "MSDS and CIS."

3.1.1 Framing

Cut and frame lumber and timber so that joints will fit over contact surface. Secure timbers and piles in alignment. Open joints are unacceptable. Shimming is not allowed. Bore holes for truss rods or bolts with a bit 1/16 inchlarger in diameter than rod or bolt. Bore holes for lag screws in two parts. Make lead hole for shank the same diameter as shank. Make lead hole for the threaded portion approximately two-thirds of the shank diameter. Bore holes in small timbers for boat or wire spikes with a bit of the same diameter or smallest dimension of the spike to prevent splitting. Counterbore for countersinking wherever smooth faces are

indicated or specified.

3.1.2 Caps

Prior to placing black flat topped PVC protective pile caps, prepare tops of posts or piles according to paragraphs entitled, "Field Treatment." Place PVC caps over tops of posts or piles to an even alignment at their ends. Secure caps with Type 316 Stainless Steel ring shank nails or lag bolts. Locate bolts in the center of pile or post.

3.1.3 Stringers

Place crown up and, if possible, the better edge of deck stringers down. Tops of stringers shall not vary from a plane more than will permit bearing of the floor on stringers. Butt-joint and splice outside stringers, but lap interior stringers to take bearing over full width of cap or floor beam at each end. Break joints if stringers cover two spans. Fasten stringers as indicated. Stringers may be of sufficient length to cover two spans, except on sharp horizontal curves. Between stringers, frame and fasten cross-bridging or solid-bridging at each end as indicated. Make size and spacing of bridging as indicated.

3.1.4 Decking

Provide and install decking of a single thickness of plank supported by stringers or joists. Unless otherwise indicated, lay plank with heart side down and with tight joints. Fasten each plank to each joist as indicated. Provide fasteners at least 4 inches greater than the thickness of plank. Place fasteners at least 2-1/2 inches from edges of the plank. Cut ends of planks parallel to center line of pier. Grade planks as to thickness and lay so that adjacent planks vary less than 1/16 inch.

3.1.5 Railing

Install railing in sections at least 12 feet long; bolt through floor plank and through outside stringer as indicated. Provide surfaced (S4S) material for railings.

3.1.6 Fastening

All fasteners and components shall be fabricated from solid Type 316 Stainless Steel material. Plated stainless steel and galvanized fasteners and components shall not be allowed. Vertical bolts shall have nuts on the lower end. Where bolts are used to fasten timber to timber, bolt members together when they are installed and retighten immediately prior to final acceptance of contract. Provide bolts having sufficient additional threading to provide at least 3/8 inch per foot thickness of timber for future retightening. Provide timber connectors of types indicated.

3.2 FIELD TREATMENT

3.2.1 Timberwork

Field treat over-drilled holes, cuts, bevels, notches, drilled holes, refacing and abrasions made in the field in treated piles or timbers as indicated in accordance with AWPA M4, MSDS and CIS. Wood preservatives are restricted use pesticides and shall be applied according to applicable standards. Trim cuts and abrasions before field treatment. Paint depressions or openings around bolt holes, joints, or gaps including

recesses formed by counterboring, with preservative treatment indicated; and after bolts for piles are in place, fill with hot pitch or a bitumastic compound.

3.2.2 Piling and Post Protection

In accordance with AWPA M4, immediately after pile or post tops are cut off and prior to placement of pile cap, protect pile or post top with several heavy applications of the same preservative used to treat the pile or post, or else copper naphthenate solutions containing a minimum of 2 percent copper metal may be used with treated products. Seal ends with of posts and piles after treatment with copper naphthenate with a heavy application of creosote followed by coal-tar pitch or other appropriate approved sealer.

3.2.3 Galvanized Surfaces

Repair and recoat zinc coating where indicated which has been field or shop cut, burned by welding, abraded, or otherwise damaged to such an extent as to expose the base metal. Thoroughly clean the damaged area by wire brushing and remove traces of welding flux and loose or cracked zinc coating prior to painting. Paint cleaned area with two coats of zinc oxide-zinc dust paint conforming to MIL-P-21035. Compound paint with a suitable vehicle in a ratio of one part zinc oxide to four parts zinc dust by weight.

-- End of Section --

SECTION 07 21 23

LOOSE FILL THERMAL INSULATION
05/11

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.

ASTM INTERNATIONAL (ASTM)

ASTM C1015	(2006; R 2011; R 2011) Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation
ASTM C516	(2008; R 2013; E 2014) Vermiculite Loose Fill Thermal Insulation
ASTM C665	(2012) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C930	(2012) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories

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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Loose fill insulation

Certification

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 C930

PART 2 PRODUCTS

2.1 LOOSE FILL INSULATION

Provide loose fill insulation conforming to the following:

a. Granular Mineral Loose Fill: ASTM C516 type II vermiculite.

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 containing material

2.2 SILL SEALER INSULATION

ASTM C665, Type I.

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 INSTALLATION

3.2.1 Insulation

Install and handle insulation in accordance with applicable provisions of ASTM C1015, 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.

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.

3.2.3 Electrical Wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.2.4 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.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 22 00

ROOF AND DECK INSULATION
08/11

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.

ASTM INTERNATIONAL (ASTM)

ASTM C726	(2012) Mineral Fiber Roof Insulation Board
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4470	(2010) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
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	(2012) Building Materials Directory

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fasteners ; G

Insulation; G

Certification

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 E84.

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 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 E84. 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 APP GUIDE. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

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; 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.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Roof insulation shall match existing.

2.1.2 Mineral-Fiber Insulation Board

ASTM C726.

2.1.3 Insulation Thickness

Match existing.

2.2 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 each in steel deck. Fasteners for steel or concrete decks shall conform to FM APP GUIDE for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 90 pounds per square foot.

2.2.1 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws conforming to FM 4470 and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of 90 psf conforming to FM APP GUIDE.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Surfaces shall be clean, smooth, and dry. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contractor shall inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

a. 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.

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 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. 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 APP GUIDE. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs.

3.2 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 roofing, 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.

3.2.1 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation with penetrating type fasteners.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with the finished roofing on same day. Do not permit phased construction. Do not permit storing or walking directly on insulation or on roofed surfaces.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.4 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 materials before, during, and after installation.

d. Inspection of mechanical fasteners; type, number, length, and spacing.

e. Coordination with other materials, cants, sleepers, and nailing strips.

f. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

g. Continuation of complete roofing system installation to cover insulation installed same day.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 41 13

METAL ROOF PANELS
05/11

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.

ALUMINUM ASSOCIATION (AA)

AA ADM	(2010) Aluminum Design Manual

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI S100	(2012) North American Specification for the Design of Cold-Formed Steel Structural Members
AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2013) 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 A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A653/A653M	(2013) Standard Specification for Steel

	Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A792/A792M	(2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C792	(2004; R 2008) Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1308	(2013) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D1667	(2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2244	(2014) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D2247	(2011) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D2794	(1993; R 2010) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D3359	(2009; E 2010; R 2010) Measuring Adhesion by Tape Test
ASTM D3363	(2005; E 2011; R 2011; E 2012) Film Hardness by Pencil Test
ASTM D4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4587	(2011) Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings

ASTM D522/D522M	(2014) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014) Standard Test Method for Specular Gloss
ASTM D5894	(2010) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D610	(2008; R 2012) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	(2002; R 2009) Evaluating Degree of Blistering of Paints
ASTM D822	(2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
ASTM D968	(2005; R 2010) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E1592	(2005; R 2012) Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E2140	(2001; R 2009) Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G152	(2013) Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	(2013) Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

FM GLOBAL (FM)

FM 4471	(2010) Class I Panel Roofs

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA RSDM	(2000) Metal Roofing Systems Design Manual

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0420	(2010) Architectural Metal Flashing, Condensation Control and Reroofing
NRCA RoofMan	(2011 thru 2014) The NRCA Roofing Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

UNDERWRITERS LABORATORIES (UL)

UL 580	(2006; Reprint Oct 2013) Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	(2012) 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 A1008/A1008M
ASTM A123/A123M
ASTM A36/A36M

ASTM D522/D522M for applied coatings
UL Bld Mat Dir

1.2.1.1 Hydrostatic Head Resistance

No water penetration when tested according to ASTM E2140. 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 E1592 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 ASCE 7, in pounds per square foot. Metal roof panels and component 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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing Panels; G

Flashing and Accessories; G

Soffit Panels; G

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Roof panels; G

Soffit Panels; G

Accessories; G

Fasteners; G

Pressure Sensitive Tape; G

Underlayments; G

Gaskets and Sealing/Insulating Compounds; G

SD-04 Samples

Roof Panels; G

Factory-applied Color Finish, samples, 9 inch lengths, full width; G

SD-05 Design Data

Wind Uplift Resistance; G

SD-06 Test Reports

Leakage Test Report; G

Wind Uplift Test Report; G

Factory Finish and Color Performance Requirements; G

SD-07 Certificates

Roof Panels; G

Coil stock compatibility; G

Qualification of Manufacturer; G

Qualification of Applicator; G

SD-08 Manufacturer's Instructions

INSULATION; G

INSTALLATION MANUAL; G

SD-11 Closeout Submittals

Warranties; G

Information Card; G

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 a minimum of five (5) years experience as an engineer knowledgeable in roof wind design analysis, protocols and procedures for MBMA RSDM, ASCE 7, UL 580, and FM 4471. Engineer must provide certified engineering calculations for the project conforming to the stated references.

1.4.1.1 Single Source

Roofing panels, clips, closures, and other accessories must be standard products of the same manufacturer, and the most recent 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/D1.1M for 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 repair paint, technical data on coil stock and coil stock compatibility, and manufacturer's installation manual.

b. Roof system components installation;

c. 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

d. Quality control plan for the roof system installation;

e. 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, 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 site and 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 forecast weather conditions permit metal 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 rolling mill to the greatest extent possible, per manufacturer's standard procedures and processes, and as necessary to fulfill indicated performance requirements. Comply with indicated profiles, dimensional and structural requirements.

Provide panel profile to match existing. Fabricate panel side laps with factory installed captive gaskets or 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.

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 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 10-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 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.8.2 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 requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the MBMA RSDM, NRCA RoofMan, 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.

PART 2 PRODUCTS

2.1 ROOF PANELS

2.1.1 Aluminum Sheet Panels

Roll-form aluminum roof panels to match existing.

Material must be plumb and true, and within the tolerances listed:

a. Aluminum sheet conforming to ASTM B209, and AA ADM

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 installed to match the existing profile:

2.1.2 Steel Sheet Panels

Roll-form steel sheet roof panels to match existing.

a. Galvanized steel sheet conforming to ASTM A653/A653M and AISI SG03-3.

b. Aluminum-Zinc alloy coated steel sheet conforming to ASTM A792/A792M 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 installed to match the existing profile.

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 plus 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 plus 0.05 mils (3.80 plus 0.05 mils for Vinyl Plastisol) for a total dry film thickness of 1.00 plus 0.10 mils (4.00 plus 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 plus 0.05 mils for a total dry fill thickness of 0.50 plus 0.10 mils. The wash coat must be oven cured.

e. Color: The exterior finish to match existing.

f. Physical Properties: Coating must conform to the industry and manufacturer's standard performance criteria as listed by the following certified test reports:

General:	ASTM D5894 and ASTM D4587
Abrasion:	ASTM D968
Adhesion:	ASTM D3359

Chalking:	ASTM D4214
Chemical Pollution:	ASTM D1308
Color Change and Conformity:	ASTM D2244
Creepage:	ASTM D1654
Cyclic Corrosion Test:	ASTM D5894
Flame Spread:	ASTM E84
Flexibility:	ASTM D522/D522M
Formability:	ASTM D522/D522M
Gloss at 60 and 85 degrees:	ASTM D523
Humidity:	ASTM D2247 and ASTM D714
Oxidation:	ASTM D610
Pencil Hardness:	ASTM D3363
Reverse Impact:	ASTM D2794
Salt Spray:	ASTM B117
Weatherometer:	ASTM G152, ASTM G153 and ASTM D822

2.2.1 Specular Gloss

Finished roof surfaces to have a specular gloss value of 10 or less at an angle of 85 degrees when measured in accordance with ASTM D523.

2.3 MISCELLANEOUS METAL FRAMING

2.3.1 General

Provide cold formed metallic-coated steel sheet conforming to ASTM A653/A653M, AISI S100 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 7 requirements.

2.3.2.1 Exposed Fasteners

Fasteners for roof panels must be corrosion resistant coated steel,aluminum, or 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, or 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, or stainless steel where watertight connections are required.

2.3.2.4 Attachment Clips

Provide hot-dip galvanized, conforming to ASTM A653/A653M, or 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. 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, compatible with the metal roof system and approved for use by the metal roof panel manufacturer.

2.4.2 Metal Closure Strips

Provide factory fabricated aluminum closure strips or steel closure strips of the same 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 D1056 and ASTM D1667, extruded or molded to the configuration of the specified roof panel profile and in lengths supplied by roof panel manufacturer.

2.4.4 Prefinished Metal Soffit Panels

Provide 8 inch metal soffit panels and all accessories to match existing in material, finish, and trim.

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 C792, 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 C792 and ASTM C920, 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 C920, 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.

2.6 INSULATION

Insulation, facer material and attachment must match existing and be compatible with metal roof system specified, as approved by the roof panel manufacturer.

2.7 UNDERLAYMENTS

Match existing.

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

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 7 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".

3.3 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.

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 0420.

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, or 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 USACE WARRANTY

CONTRACTOR'S TEN (10) 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 TEN (10) 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 TEN (10) 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 TEN (10)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 60 00

FLASHING AND SHEET METAL
08/08

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 WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	(2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B32	(2008) Standard Specification for Solder Metal
ASTM D226/D226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D41/D41M	(2011) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D4586/D4586M	(2007; E 2012; R 2012) Asphalt Roof Cement, Asbestos-Free

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

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 responsible 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

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fascias; G

Base flashing; G

Flashing at roof penetrations; G

Drip edge; G

Eave flashing; G

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.

1.4 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

Match existing. 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.

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 required to match existing. 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: base, and eave flashings and related accessories.

2.1.2 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A653/A653M.

2.1.2.1 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 to match exisiting.

2.1.3 Stainless Steel

ASTM A167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.4 Aluminum Alloy Sheet and Plate

ASTM B209 color to match existing and temper appropriate for use.

2.1.4.1 Alclad

When fabricated of aluminum, fabricate the items Alclad 3003, Alclad 3004, Alclad 3005, clad on both sides unless otherwise indicated.

Flashing

2.1.4.2 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 to match existing.

2.1.5 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B221.

2.1.6 Solder

ASTM B32, 95-5 tin-antimony.

2.1.7 Bituminous Plastic Cement

ASTM D4586/D4586M, Type I.

2.1.8 Roofing Felt

ASTM D226/D226M.

2.1.9 Asphalt Primer

ASTM D41/D41M.

2.1.10 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 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 1793, 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.

3.1.2 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.

3.1.3 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.

3.1.4 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.

3.1.5 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.5.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.5.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inch.

3.1.5.3 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.

3.1.5.4 Standing Seams

Not less than one inch high, double locked without solder.

3.1.5.5 Flat Seams

Make seams in the direction of the flow.

3.1.6 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.

3.1.6.1 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.

3.1.7 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.

3.1.7.1 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.

3.1.7.2 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.

3.1.8 Protection from Contact with Dissimilar Materials

3.1.8.1 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.

3.1.8.2 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.8.3 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.

3.1.9 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.

3.1.10 Base Flashing

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 with the previously laid flashing not less than 3 inch. Fasten the strips at their upper edge to the deck. Install and fit the flashings so as to be completely weathertight.

3.1.11 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. 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.

3.1.11.1 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.

3.1.11.2 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.

3.1.12 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. 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.

3.1.13 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.

3.1.14 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.

3.1.15 Expansion Joints

Provide expansion joints in continuous sheet metal at 40 foot intervals for stainless steel and at 32 foot intervals for aluminum, aluminum 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.

3.2 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.

-- End of Section --

SECTION 07 81 00

SPRAY-APPLIED FIREPROOFING
02/11

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

1.1.1 General Requirements

Provide intumescent coating at top of CMU exterior walls to conceal spray foam installed to seal gaps.

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. **For this specification, NAVFAC signifies the office that will review the submittal for the Government to be Southeast Division, EFA Naval Facilities Engineering Command Fire Protection Engineer.** Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fireproofing Material; G, NVFAC

SD-06 Test Reports

Fire Resistance Rating; G, NVFAC

1.3 DELIVERY, STORAGE, AND HANDLING

Delover packaged material in the original unopened containers, marked to show the brand name, the manufacturer, and the UL markings. Keep fireproofing material dry until ready to be used, and store off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Apply material with shelf-life prior to expiration of the shelf-life.

1.4 PROJECT/SITE CONDITIONS

1.4.1 Temperature

Maintain substrate and ambient air temperatures above 40 degrees F during application and for 24 hours before and after application. Maintain relative humidity within the limits recommended by the fireproofing manufacturer.

1.4.2 Ventilation

Provide adequate ventilation to properly dry the fireproofing after application. In enclosed areas, provide a minimum of 4 air exchanges per hour by forced air circulation.

PART 2 PRODUCTS

2.1 SPRAY-APPLIED INTUMESCENT EPOXY COATING SYSTEM

Provide a two-component epoxy based intumescent fire protective coating that meets the following requirements.

a. On curing it forms a flexible and tough epoxy barrier which transforms into a ceramic-like, insulating char to provide thermal protection of the substrate in the event of a fire.

b. The coating system includes the manufacturer's required surface preparation, primer, and fire protective layer, and topcoat.

c. The coating system protects the substrate from corrosion and retain its fire protection properties under aggressive chemical environments.

d. Resistant to solvents, acids, alkalis, salts and abrasion while retaining its fire protective properties.

Provide a system that exhibits the following properties:

2.1.1 Percent Solids by Weight

100 percent

2.1.2 In Service Temperature Restrictions

Up to 150 degrees F

2.1.3 Application Method

Air spray or specialized plural component airless equipment approved by the manufacture. Troweling can be used for small areas or touch-up work.

2.1.4 Drying Time

Approximately 24 hours to achieve a Shore D hardness of 25.

2.1.5 Shelf Life

Minimum shelf life under proper storage condition is 1 Year from date of manufacture.

2.1.6 Pot Life

Approximately 40 minutes at 77 degrees F and 50 percent relative humidity. Pot life is not a factor when using specialized plural component airless spray equipment.

2.1.7 Flash Point

Greater than 212 degrees F Pensky-Martens for each component.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Thoroughly clean surfaces to be fireproofed of dirt, grease, oil, paint,

primers, loose rust, rolling lubricant, mill scale or other contaminants that will interfere with the proper bonding of the sprayed fireproofing to the substrate. Condition of the surfaces shall be acceptable to the manufacturer prior to application of spray-applied fireproofing.

3.2 APPLICATION

3.2.1 Application of Spray-Applied Intumescent Epoxy Coating System

Prepare surfaces and apply the spray-applied Intumescent epoxy coating system in accordance with the manufacturer's written recommendations.

3.3 CLEANUP

Thoroughly clean surfaces not indicated to receive fireproofing of sprayed material within a 24 hour period after application.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

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.

ASTM INTERNATIONAL (ASTM)

ASTM C509	(2006; R 2011) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

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. 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. Label 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.

1.6 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 C920, 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.	Match Wall Finish
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	Match Masonry Finish
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	Match Wall Finish
d. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	Match Wall Finish

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, 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 metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b. Joints between new and existing exterior masonry walls.	Match Adjacent Surface Color
c. Masonry joints where shelf angles occur.	Match Adjacent Surface Color
e. Expansion and control joints.	Match Adjacent Surface Color
f. Expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Match Adjacent Surface Color
g. Voids where items pass through exterior walls.	Match Adjacent Surface Color
h. Metal-to-metal joints where sealant is indicated or specified.	Match Adjacent Surface Color
i. Joints between ends of gravel stops, fascias, copings, and adjacent walls.	Match Adjacent Surface Color

2.1.3 Floor Joint Sealant

ASTM C920, 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.	Gray
b. Control and expansion joints in floors.	Gray

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 D1056, Type 2, closed cell, Class A, Grade N5, round cross section for cellular rubber sponge backing.

2.4.2 Synthetic Rubber

Conform to ASTM C509, Option I, Type I preformed rods or tubes for Synthetic rubber backing.

2.4.3 Neoprene

Conform to ASTM D1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for Neoprene backing.

2.5 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 caulk 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 or masonry:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
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 --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08 11 13

STEEL DOORS AND FRAMES
02/10

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.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A879/A879M	(2012) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A924/A924M	(2013) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C578	(2014) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	(2013) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C612	(2014) Mineral Fiber Block and Board Thermal Insulation
ASTM D2863	(2013) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115	(2006) Hardware Preparation in Steel Doors and Steel Frames

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	(2009) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and

	Accessories
SDI/DOOR 113	(2001; R2006) Standard Practice for 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 A250.4	(2011) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing
SDI/DOOR A250.6	(2003; R2009) Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Show elevations, construction details, metal gages, hardware provisions, and installation details.

Submit door and frame locations.

SD-03 Product Data

Doors; G

Frames; G

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. 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 as specified in Section 08 71 00. 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 Classification - Level, Performance, Model

2.1.1.1 Maximum Duty Doors

SDI/DOOR A250.8, Level 4, physical performance Level A, Model 1 with core construction as required by the manufacturer 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.

2.2 INSULATED STEEL DOOR SYSTEMS

Insulated steel doors shall have a core of polyurethane foam and an R factor of 10.0 or more (based on a k value of 0.16); face sheets, edges, and frames of galvanized steel not lighter than 23 gage, 16 gage, and 16 gage respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Doors and frames shall receive phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Doors shall have been tested in accordance with SDI/DOOR A250.4 and shall have met the requirements for Level C. Prepare doors to receive specified hardware.Doors shall be 1-3/4 inch thick.

2.3 ACCESSORIES

2.3.1 Louvers

2.3.2 Astragals

For pairs of exterior steel doors provide overlapping steel astragals with the doors.

2.3.3 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.

2.4 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 Cellular Polyisocyanurate Foam: ASTM C591, 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 D2863; or

b. Rigid Polystyrene Foam Board: ASTM C578, Type I or II; or

c. Mineral board: ASTM C612, Type I.

2.5 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 4, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors unless otherwise indicated.

2.5.1 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.

2.5.2 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.

2.5.2.1 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. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

2.5.2.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.6 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.7 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

ANSI/BHMA A156.115. 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 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.

2.8 FINISHES

2.8.1 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.

2.8.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924Mand ASTM A653/A653M. 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. .

2.8.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A879/A879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.9 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. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

2.9.1 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. 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, clean and adjust hardware.

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 71 00

DOOR HARDWARE
08/08

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.

ASTM INTERNATIONAL (ASTM)

ASTM E283	(2004; R 2012) 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)

ANSI/BHMA A156.1	(2013) Butts and Hinges
ANSI/BHMA A156.13	(2012) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16	(2013) Auxiliary Hardware
ANSI/BHMA A156.18	(2012) Materials and Finishes
ANSI/BHMA A156.21	(2009) Thresholds
ANSI/BHMA A156.3	(2014) Exit Devices
ANSI/BHMA A156.4	(2013) Door Controls - Closers
ANSI/BHMA A156.6	(2010) Architectural Door Trim
ANSI/BHMA A156.7	(2003; R 2009) Template Hinge Dimensions
ANSI/BHMA A156.8	(2010) Door Controls - Overhead Stops and Holders
BHMA A156.15	(2011) Release Devices Closer Holder, Electromagnetic and Electromechanical
BHMA A156.22	(2012) Door Gasketing and Edge Seal Systems

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Hardware schedule; G

SD-03 Product Data

Hardware items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G

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:

Hardware Item	Quantity	Size	Reference Publi-cation Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed	BHMA Finish Desig-nation

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, 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 manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, locks, latches, 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.

2.2.1 Hinges

ANSI/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.

2.2.2 Locks and Latches

2.2.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. 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.

2.2.3 Cylinders and Cores

Provide cylinders and cores with seven pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer.

2.2.4 Keying System

Provide a extension of the existing keying system. Existing locks were manufactured by Best Locks and have interchangeable cores. Provide construction interchangeable cores.

2.2.5 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.2.5.1 Lever Handles

Provide lever handles in lieu of knobs . Conform to the minimum requirements of ANSI/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 ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.2.6 Keys

Furnish one file key, one duplicate key, and one working key for each key change . Furnish one additional working key for each lock of each keyed-alike group. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.2.7 Door Bolts

ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: ANSI/BHMA A156.3, Type 25.

2.2.8 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations. Provide manufacturer's 10 year warranty.

2.2.8.1 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.

2.2.9 Overhead Holders

ANSI/BHMA A156.8.

2.2.10 Closer Holder-Release Devices

BHMA A156.15.

2.2.11 Door Protection Plates

ANSI/BHMA A156.6.

2.2.11.1 Sizes of Kick Plates

2 inch less than door width for single doors; one inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doors.

2.2.12 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.2.13 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.2.14 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 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weather stripping with the following:

2.2.14.1 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) anodized aluminum.

2.2.15 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, clear anodized. Set drips in sealant and fasten with stainless steel screws.

2.2.15.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.2.15.2 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.2.16 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.3 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.

2.4 FINISHES

ANSI/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 finish for surface door closers, and except BHMA 652 finish (satin chromium plated) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish. Match exposed parts of concealed closers to lock and door trim.

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.

3.1.2 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 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick lates: Push side of single-acting doors.

3.3 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.

3.4 HARDWARE SETS

Provide as indicated on the drawings.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS
05/11

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 CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100	(2001; Supplements 2002-2008) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM D235	(2002; R 2012) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D4263	(1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D523	(2014) Standard Test Method for Specular Gloss
ASTM D6386	(2010) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM F1869	(2011) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 101	(Oct 2009) Epoxy Anti-Corrosive Metal Primer
MPI 107	(Oct 2009) Rust Inhibitive Primer (Water-Based)
MPI 108	(Oct 2009) High Build Epoxy Coating, Low Gloss
MPI 11	(Oct 2009) Exterior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 113	(Oct 2009) Exterior Pigmented Elastomeric Coating (Water Based)
MPI 134	(Oct 2009) Galvanized Primer (Waterbased)

MPI 140	(Oct 2009) Interior High Performance Latex, MPI Gloss Level 4
MPI 141	(Oct 2009) Interior High Performance Latex MPI Gloss Level 5
MPI 163	(Oct 2009) Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 23	(Oct 2009) Surface Tolerant Metal Primer
MPI 26	(Oct 2009) Cementitious Galvanized Metal Primer
MPI 4	(Oct 2009) Interior/Exterior Latex Block Filler
MPI 47	(Oct 2009) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 50	(Oct 2009) Interior Latex Primer Sealer
MPI 52	(Oct 2009) Interior Latex, MPI Gloss Level 3
MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer
MPI 94	(Oct 2009) Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 95	(Oct 2009) Quick Drying Primer for Aluminum

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007; E 2004) Brush-Off Blast Cleaning
SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP 12/NACE No.5	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	(1982; E 2000; E 2004) Hand Tool Cleaning
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial 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) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 2011) Safety and Health Requirements Manual

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313 (2014; Rev E) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

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

29 CFR 1910.1000 Air Contaminants

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. Submit the following 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.

SD-03 Product Data

Coating; G

Manufacturer's Technical Data Sheets

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:; G

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.3 REGULATORY REQUIREMENTS

1.3.1 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.

1.3.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.3.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.3.4 Asbestos Content

Materials shall not contain asbestos.

1.3.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.3.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.3.7 Human Carcinogens

Materials shall not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.4 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.

1.5 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.

1.5.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.5.2 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 0100, threshold limit values.

1.6 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.6.1 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.

1.7 COLOR SELECTION

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 match existing or as indicated.

1.8 LOCATION AND SURFACE TYPE TO BE PAINTED

1.8.1 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.

1.8.1.1 Exterior Painting

Includes new surfaces and existing coated surfaces, of the building and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.8.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations.

1.8.2 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. Steel to be embedded in concrete.

c. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

d. Hardware, fittings, and other factory finished items.

1.8.3 Definitions and Abbreviations

1.8.3.1 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.

1.8.3.2 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.

1.8.3.3 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.

1.8.3.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.8.3.5 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.

1.8.3.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.8.3.7 EXT

MPI short term designation for an exterior coating system.

1.8.3.8 INT

MPI short term designation for an interior coating system.

1.8.3.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.8.3.10 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.

1.8.3.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.8.3.12 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 at 60 degrees	Units at 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 D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.8.3.13 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.

1.8.3.14 Paint

See Coating definition.

1.8.3.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.8.3.16 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 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, 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.

3.2.1 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.

3.3 PREPARATION OF METAL SURFACES

3.3.1 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. Brush-off blast remaining surface in accordance with SSPC 7/NACE No.4; 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/NACE No.3 /SSPC SP 12/NACE No.5 WJ-3.

3.3.2 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 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent 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 D6386, 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/NACE No.5 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: Spot abrasive blast rusted areas as described for steel in SSPC SP 6/NACE No.3, and waterjet to SSPC SP 12/NACE No.5, WJ3 to remove existing coating.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D235. Wipe dry with clean, dry cloths.

3.3.6 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.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete 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.

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 D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.5 APPLICATION

3.5.1 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.

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.

3.5.2 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 1 pint of suitable thinner per 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.

3.5.3 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.

3.5.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table

Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous 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.

3.6 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.

3.7 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.8 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.

3.9 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. Set aside extra paint for future color matches or reuse by the Government.

3.10 PAINT TABLES

All DFT's are minimum values. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.10.1 EXTERIOR PAINT TABLES

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. 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

B. New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3:

1. 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

C. Existing steel that has been spot-blasted to SSPC SP 6/NACE No.3:

1. Surface previously coated with alkyd or latex:

   Waterborne Light Industrial Coating
   MPI REX 5.1C-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:

STEEL / FERROUS SURFACES

MPI 79	MPI 163	MPI 163

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

D. New and existing steel blast cleaned to SSPC SP 10/NACE No. 2:

1. Waterborne Light Industrial
MPI EXT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 163

System DFT: 8.5 mils

E. New Galvanized surfaces:

1. Cementitious primer / Latex
MPI EXT 5.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 26	MPI 11	MPI 11

System DFT: 4.5 mils

2. 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

3. 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

F. 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

G. 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

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

A. 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-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 94	MPI 94

   System DFT: 5 mils

2. Waterborne Light Industrial Coating
   MPI EXT 5.4G-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 163	MPI 163

   System DFT: 5 mils

3.10.2 INTERIOR PAINT TABLES

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New and uncoated Existing Concrete masonry:

1. High Performance Architectural Latex
   MPI INT 4.2D-G4 (Satin)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 140	MPI 140

   System DFT: 11 mils
   Fill all holes in masonry surface

B. Existing, previously painted Concrete masonry:

1. High Performance Architectural Latex
   MPI RIN 4.2K-G4

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 140	MPI 140

   System DFT: 4.5 mils

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

   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-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 47	MPI 47

   System DFT: 5 mils

B. New Wallboard not otherwise specified:

1. Latex
   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

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 10 44 16

FIRE EXTINGUISHERS
05/12

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)

ICC IFC	(2012) International Fire Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1	(2012; TIA 11-1) Fire Code
NFPA 10	(2013) Standard for Portable Fire Extinguishers
NFPA 101	(2015) Life Safety Code
NFPA 303	(2011) Fire Protection Standards for Marinas and Boatyards
NFPA 385	(2012) Standard for Tank Vehicles for Flammable and Combustible Liquids
NFPA 409	(2011; Errata 11-1) Standard on Aircraft Hangars
NFPA 418	(2011) Standard for Heliports
NFPA 99	(2015) Health Care Facilities Code

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

29 CFR 1910.106	Flammable and Combustible Liquids
29 CFR 1910.157	(2003) Portable Fire Extinguishers

UNDERWRITERS LABORATORIES (UL)

UL 299	(2012) Dry Chemical Fire Extinguishers

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Manufacturer's Data

SD-02 Shop Drawings

Fire Extinguishers

Accessories

Wall Brackets

SD-03 Product Data

Fire Extinguishers

Accessories

Wall Brackets

Replacement Parts

SD-07 Certificates

Fire Extinguishers

Manufacturer's Warranty with Inspection Tag

1.3 DELIVERABLES

1.4 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.

PART 2 PRODUCTS

Submit fabrication drawings consisting of fabrication and assembly details performed in the factory and product data for the following items: Fire Extinguishers; Accessories, Wall Brackets.

2.1 TYPES

Submit certificates that show Fire Extinguishers comply with local codes and regulations.

Provide Fire Extinguishers conforming to NFPA 10. Provide quantity and placement in compliance with the applicable sections of ICC IFC, Section 1414 and ICC IFC, Section 906, NFPA 1, NFPA 101, NFPA 99, NFPA 303, NFPA 385, NFPA 409, NFPA 418,29 CFR 1910.106 and 29 CFR 1910.157.

Provide dry chemical type fire extinguishers compliant with UL 299.

Submit Manufacturer's Data for each type of Fire Extinguisher required, detailing all related Wall Mounting and Accessories information, complete with Manufacturer's Warranty with Inspection Tag.

2.2 MATERIAL

Provide corrosion-resistant steel or enameled steel extinguisher shell.

2.3 SIZE

10 pounds extinguishers.

2.4 ACCESSORIES

Forged brass valve

Fusible plug

Safety release

Antifreeze

Pressure gage

2.5 WALL BRACKETS

Provide spring-clip fire extinguisher wall brackets.

Provide wall bracket and accessories 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.

Submit 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 --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS
08/10

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 within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality
ASHRAE 70	(2006) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 90.1 - IP	(2007; Supplement 2008; Addenda r 2009) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 924/A 924M	(2010) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 766	(1986; R 2008) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C 553	(2008) Standard Specification for Mineral

	Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM D 1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 3359	(2009; E 2010) Measuring Adhesion by Tape Test
ASTM D 520	(2000; R 2005) Zinc Dust Pigment
ASTM E 2016	(2006) Standard Specification for Industrial Woven Wire Cloth

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2009) Motors and Generators
NEMA MG 10	(2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1997; R 2001; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2009; Errata 09-1) Standard for the Installation of Air Conditioning and Ventilating Systems

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1650	(2008) Seismic Restraint Manual Guidelines for Mechanical Systems, 2nd Edition
SMACNA 1966	(2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

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

40 CFR 82	Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 214	(1997; Rev thru Aug 2001) Tests for Flame-Propagation of Fabrics and Films
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL Bld Mat Dir	(2012) Building Materials Directory
UL Electrical Constructn	(2009) Electrical Construction Equipment Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Mechanical Equipment Identification

The number of charts and diagrams shall be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics.

1.2.1.2 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. provide neat mechanical drawings provided with extruded aluminum frame under 1/8-inch glass or laminated plastic, system diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Labels shall be in accordance with the designations on the construction documents.

Identify similar services with different temperatures or pressures. Where pressures could exceed 125 pounds per square inch, gage, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels shall be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

1.2.3 Color Coding

Color coding of all piping systems shall be in accordance with ASME A13.1.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Manual Balancing Dampers; G
Diffusers
Registers and Grilles
Air Vents, Penthouses, and Goosenecks
Air Handling Units; G
Room Fan-Coil Units; G

Diagrams; G

SD-06 Test Reports

Performance Tests; G
Damper Acceptance Test; G

SD-07 Certificates

Bolts
Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions
Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Manual Balancing Dampers; G
Air Handling Units; G
Room Fan-Coil Units; G

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Manufacturer shall provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with ASTM B 766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Used as Refrigerants

Minimize releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances containing ODS's by complying with all applicable sections of 40 CFR 82 Part 82 Subpart F. Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA shall comply with the following:

a. Do not knowingly vent or otherwise release into the environment, Class I or Class II substances used as a refrigerant.

b. Do not open appliances without meeting the requirements of 40 CFR 82 Part 82.156 Subpart F, regarding required practices for evacuation and collection of refrigerant, and 40 CFR 82 Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.

c. Only persons who comply with 40 CFR 82 Part 82.161 Subpart F, regarding technician certification, can conduct work on appliances containing refrigerant.

In addition, provide copies of all applicable certifications to the Contracting Officer at least 14 calendar days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

a. Proof of Technician Certification

b. Proof of Equipment Certification for recovery or recycling equipment.

c. Proof of availability of certified recovery or recycling equipment.

1.4.4 Use of Ozone Depleting Substances, Other than Refrigerants

The use of Class I or Class II ODS's listed as nonessential in 40 CFR 82 Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

a. Any plastic party spray streamer or noise horn which is propelled by a chlorofluorocarbon

b. Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays

c. Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam used in coaxial

d. Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR 82 Part 82.66 Subpart C.

Request a waiver if a facility requirement dictates that a prohibited material is necessary to achieve project goals. Submit the waiver request in writing to the Contracting Officer. The waiver will be evaluated and dispositioned.

1.4.5 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly

as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.6 Test Procedures

Submit proposed test procedures and test schedules for the ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

1.4.7 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. Where applicable, provide equipment that is an ENERGY STAR Qualified product or a Federal Energy Management Program (FEMP) designated product.

2.3 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Install identification plates using a compatible adhesive.

2.4 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard.

2.5 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system , and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.

d. 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. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

2.6 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.7 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in SMACNA 1650

2.8 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's

standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.9 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.10 DUCT SYSTEMS

2.10.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification .

a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.

b. Provide ductwork that meets the requirements of Seal Class A.

c. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant.

d. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.10.1.3 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with UL 214 and is classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.10.4 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are

operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.10.9 Air Supply And Exhaust Air Dampers

Where outdoor air supply and exhaust air dampers are required they shall have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP, including:

Maximum Damper Leakage for:

1) Climate Zones 1,2,6,7,8 the maximum damper leakage at 1.0 inch w.g. for motorized dampers is 4 cfm per square foot of damper area and non-motorized dampers are not allowed.

2) All other Climate Zones the maximum damper leakage at 1.0 inch w.g. is 10 cfm per square foot and for non-motorized dampers is 20 cfm per square foot of damper area.

Dampers smaller than 24 inches in either direction may have leakage of 40 cfm per square foot.

2.10.10 Air Deflectors and Branch Connections

Provide air deflectors at all duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections are allowed in lieu of deflectors for branch connections. Furnish all air deflectors, except those installed in 90 degree elbows, with an approved means of adjustment. Provide easily accessible means for adjustment inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, provide external adjustments with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Provide factory-fabricated air deflectors consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Provide factory or field assembled air deflectors. Make adjustment from the face of the diffuser or by position adjustment and lock external to the duct. Provide stand-off brackets on insulated ducts as described herein. Provide fixed air deflectors, also called turning vanes, in 90 degree elbows.

2.10.11 Plenums and Casings for Field-Fabricated Units

2.10.11.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components are allowed for field-assembled units, provided all requirements specified for field-fabricated plenums and

casings are met. Provide panels of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Seal and insulate panel joints. Provide and gasket access doors to prevent air leakage. Provide panel construction that is not less than 20 gauge galvanized sheet steel, assembled with fasteners treated against corrosion. Provide standard length panels that deflect not more than 1/2 inch under operation. Construct details, including joint sealing, not specifically covered, as indicated in SMACNA 1966. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

2.10.11.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.10.13 Diffusers, Registers, and Grilles

Provide factory-fabricated units of aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.10.13.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Constructn for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.10.13.5 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.10.16 Bird Screens and Frames

Provide bird screens that conform to ASTM E 2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.15 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A 123/A 123M or ASTM A 924/A 924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D 520 Type I.

Factory painting that has been damaged prior to acceptance by the Contracting Officer shall be field painted in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.16 SUPPLEMENTAL COMPONENTS/SERVICES

2.16.2 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

2.16.4 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate.

2.16.6 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.16.7 Controls

The requirements for controls are specified in Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices)and an additional 3 feet.

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS. Provide concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided

and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.9 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.10 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.11 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.2.13 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C 553, Type 1, Class B-2.

a. Sleeves: Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A 53/A 53M, Schedule 20.

b. Framed Prepared Openings: Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

c. Insulation: Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

d. Closure Collars: Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

e. Firestopping: Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials.

3.7 FIELD PAINTING OF MECHANICAL EQUIPMENT

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 clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. 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. Provide aluminum or light gray finish coat.

a. Temperatures less than 120 degrees F: Immediately after cleaning, apply 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 to metal surfaces subject to temperatures less than 120 degrees F.

b. Temperatures between 120 and 400 degrees F: Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

c. Temperatures greater than 400 degrees F: Apply two coats of 315 degrees C 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of two mils to metal surfaces subject to temperatures greater than 400 degrees F.

3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.11 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Operate all fire dampers and smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.

3.12 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.13 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified. Conduct capacity tests and general operating tests by an experienced engineer. Provide tests that cover a period of not less than 7 days for each system and demonstrate that the entire system is functioning according to the specifications. Make coincidental chart

recordings at points indicated on the drawings for the duration of the time period and record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

Submit test reports for the ductwork leak test, and performance tests in booklet form, upon completion of testing. Document phases of tests performed including initial test summary, repairs/adjustments made, and final test results in the reports.

3.14 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of room fan-coil units thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.15 OPERATION AND MAINTENANCE

3.15.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23.00 25 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.15.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of 16 hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS
08/10

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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2009) Motors and Generators
NEMA MG 10	(2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1997; R 2001; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

1.3 RELATED REQUIREMENTS

This section applies to all sections of Divisions: 21, FIRE SUPPRESSION; 22, PLUMBING; and 23, HEATING, VENTILATING, AND AIR CONDITIONING of this project specification, unless specified otherwise in the individual section.

1.4 QUALITY ASSURANCE

1.4.1 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.

1.4.2 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.

1.4.3 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.

1.4.4 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.

1.4.5 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.

1.4.5.1 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."

1.4.5.2 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.

1.5 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.

1.6 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.

1.7 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.7.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters, 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 26, 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.

1.7.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

1.7.3 High Efficiency Motors

1.7.3.1 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.

1.7.3.2 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 12-6C of NEMA MG 1.

1.7.4 Three-Phase Motor Protection

Provide controllers for motors rated one 1 horsepower 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.

1.8 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

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

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 1 mil; and two coats of enamel applied to a minimum dry film thickness of 1 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.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 05 15

COMMON PIPING FOR HVAC
02/09

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	(2011) Steel Construction Manual

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2004) Specification for Filler Metals for Brazing and Braze Welding
AWS WHB-2.9	(2004) Welding Handbook; Volume 2, Welding Processes, Part 1

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.22	(2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.9	(2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.3	(2008) Process Piping

ASTM INTERNATIONAL (ASTM)

ASTM A 126	(2004; R 2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 234/A 234M	(2010) 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 117	(2009) Standing Practice for Operating

	Salt Spray (Fog) Apparatus
ASTM B 32	(2008) Standard Specification for Solder Metal
ASTM B 62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM D 2000	(2008) Standard Classification System for Rubber Products in Automotive Applications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	(2002a) Butterfly Valves
MSS SP-69	(2003) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-72	(2010) Ball Valves with Flanged or Butt-Welding Ends for General Service

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2009) Motors and Generators
NEMA MG 10	(2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1997; R 2001; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013;Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922	(Rev A; Notice 2) Shield, Expansion

	(Caulking Anchors, Single Lead)
CID A-A-1923	(Rev A; Notice 2) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 2) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	(Rev A; Notice 2) Shield Expansion (Nail Anchors)
CID A-A-55614	(Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Basic; Notice 2) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors

1.2 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Submit Records of Existing Conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes Contractor's acceptance of the existing conditions.

Include with Equipment Foundation Data for piping systems all plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

Submit Fabrication Drawings for pipes, valves and specialties consisting of fabrication and assembly details to be performed in the factory.

Submit Material, Equipment, and Fixture Lists for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Provide a complete list of construction equipment to be used.

Submit Manufacturer's Standard Color Charts for pipes, valves and specialties showing the manufacturer's recommended color and finish selections.

Include with Listing of Product Installations for piping systems identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Include in the list purchaser, address of installation, service organization, and date of installation.

Submit Record Drawings for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

Submit Connection Diagrams for pipes, valves and specialties indicating the relations and connections of devices and apparatus by showing the general

physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for construction equipment to be used.

SD-02 Shop Drawings

Submit the following for pipes, valves and specialties showing conformance with the referenced standards contained within this section.

Record Drawings
Connection Diagrams
Coordination Drawings
Fabrication Drawings

Submit Installation Drawings for pipes, valves and specialties in accordance with the paragraph entitled, "Pipe Installation," of this section.

SD-03 Product Data

Submit equipment and performance data for the following items consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Submit Manufacturer's catalog data for the following items:

Pipe and Fittings
Valves
Supporting Elements

Equipment Foundation Data shall be in accordance with paragraph entitled, "General Requirements," of this section.

SD-04 Samples

Submit Manufacturer's Standard Color Charts in accordance with paragraph entitled, "General Requirements," of this section.

SD-05 Design Data

Submit design analysis and calculations for the following items consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

Pipe and Fittings
Valves

SD-06 Test Reports

Submit test reports on the following tests in accordance with paragraph entitled, "Piping Installation," of this section.

Hydrostatic Tests
Air Tests
Valve-Operating Tests
Drainage Tests
Pneumatic Tests
Non-Destructive Electric Tests
System Operation Tests

SD-07 Certificates

Submit Listing of Product Installations for piping systems verifying proper qualifications.

Submit Records of Existing Conditions by the Contractor prior to start.

Submit Certificates for the following in accordance with paragraph entitled, "Pipe Installation," of this section.

Surface Resistance
Shear and Tensile Strengths
Temperature Ratings
Bending Tests
Flattening Tests
Transverse Guided Weld Bend Tests

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.4 QUALITY ASSURANCE

1.4.1 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.

1.4.2 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.

1.4.3 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.

1.4.4 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.

1.4.5 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.

1.4.5.1 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."

1.4.5.2 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.

1.5 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.

1.6 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.

1.7 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.7.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters, 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 are not permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits shall be provided under Division 26, 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.

1.7.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

1.7.3 High Efficiency Motors

1.7.3.1 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.

1.7.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, select polyphase motors 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 12-6C of NEMA MG 1.

1.7.4 Three-Phase Motor Protection

Provide controllers for motors rated one one horsepower 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.

1.8 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 trained in operating theory as well as practical operation and maintenance work.

Give instruction 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

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

2.2 PIPE AND FITTINGS

2.2.6 Type CPR, Copper

2.2.6.1 Type CPR-A, Copper Above Ground

Tubing 2 inches and under shall be seamless copper tubing, conforming to ASTM B 88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Fittings 2 inches and under shall be 150-psigwsp wrought-copper solder joint fittings conforming to ASME B16.22.

Unions 2 inches and under shall be 150-psig wsp wrought-copper solder joint, conforming to ASME B16.22.

Provide brazing rod with Classification BCuP-5, conforming to AWS A5.8/A5.8M.

Solder must be 60-40 tin-antimony, alloy Sb-5, conforming to ASTM B 32.

2.2.7 Grooved Pipe Couplings and Fittings

Provide housing for all couplings, fabricated in two or more parts, of black, ungalvanized malleable iron castings. Coupling gasket shall be molded synthetic rubber, conforming to ASTM D 2000. Coupling bolts shall be oval-neck, track-head type, with hexagonal heavy nuts conforming to ASTM A 183.

Fabricate all pipe fittings used with couplings of black, ungalvanized malleable iron castings. Where a manufacturer's standard-size malleable iron fitting pattern is not available, approved fabricated fittings may be used.

Fabricate fittings from Schedule 40 or 0.75-inch wall ASTM A 53/A 53M, Grade B seamless steel pipe; long radius seamless welding fittings with wall thickness to match pipe, conforming to ASTM A 234/A 234M and ASME B16.9.

2.4 VALVES

2.4.1 Ball and Butterfly Valves

Ball valves shall conform to MSS SP-72 for Figure 1A, 1 piece body and shall be rated for service at not less than 175 psig at 200 degrees F. Valve bodies in sizes 2 inches and smaller shall be screwed-end connection-type constructed of Class A copper alloy. Balls and stems of valves 2 inches and smaller shall be manufacturer's standard with hard chrome plating finish. Valves shall be suitable for flow from either direction and shall seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. All valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.

Butterfly valves shall conform to MSS SP-67. Valves shall be wafer type for mounting between specified flanges and shall be rated for 150-psig shutoff and nonshock working pressure. Bodies shall be cast ferrous metal conforming to ASTM A 126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals shall be of the resilient elastomer type designed for field removal and replacement.

2.4.2 Drain, Vent, and Gage Cocks

Drain, vent, and gage cocks shall be lever handle, ground key type, with washer and screw, constructed of polished ASTM B 62 bronze, and rated 125-psi wsp. End connections shall be rated for specified service pressure.

Pump vent cocks, and where spray control is required, shall be UL umbrella-hood type, constructed of manufacturer's standard polished brass. Cocks shall be 1/2-inch ips male, end threaded, and rated at not less than 125 psi at 225 degrees F.

2.6 SUPPORTING ELEMENTS

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. All supporting elements

shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements shall conform to requirements of ASME B31.3, MSS SP-58, and MSS SP-69 except as noted.

Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Supporting elements exposed to weather shall be hot-dip galvanized or stainless steel. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925 , CID A-A-55614, and CID A-A-55615. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

2.6.1 Building Structure Attachments

2.6.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925 , CID A-A-55614, and CID A-A-55615

Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

2.6.1.2 Beam Clamps

Beam clamps shall be center-loading MSS SP-58 Type 20, 21, 28, 29, 30.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, MSS SP-58 Type 20, 25, 27 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, rod diameter shall be determined in accordance with referenced standards.

2.6.1.3 C-Clamps

Do not use C-clamps.

2.6.1.4 Inserts, Concrete

Concrete inserts shall be MSS SP-58 Type 18. When applied to piping in sizes 2 inches ips and larger and where otherwise required by imposed loads, insert and wire a 1-foot length of 1/2-inch reinforcing rod through wing slots. Submit proprietary-type continuous inserts for approval.

2.6.2 Horizontal Pipe Attachments

2.6.2.1 Single Pipes

Support piping in sizes to and including 2-inch ips by MSS SP-58 Type 6 solid malleable iron pipe rings, except that split-band-type rings shall be used in sizes up to 1-inch ips.

MSS SP-58 Type 1 and Type 6 assemblies shall be used on vapor-sealed insulated piping and shall have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

MSS SP-58 Type 40 shields shall be used on all insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

Provide insulated piping without vapor barrier on roll supports with MSS SP-58 Type 39 saddles.

Spring supports shall be as indicated.

2.6.2.2 Parallel Pipes

Trapeze hangers fabricated from structural steel shapes, with U-bolts, shall be used in congested areas and where multiple pipe runs occur. Structural steel shapes shall be of commercially available, proprietary design, rolled steel.

2.6.3 Vertical Pipe Attachments

Vertical pipe attachments shall be MSS SP-58 Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.6.4 Hanger Rods and Fixtures

Only circular cross section rod hangers shall be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved by the Contracting Officer.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.6.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC 325.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Submit certificates for pipes, valves and specialties showing conformance

with test requirements as contained in the reference standards contained in this section. Certificates shall verify Surface Resistance, Shear and Tensile Strengths, Temperature Ratings, Bending Tests, Flattening Tests and Transverse Guided Weld Bend Tests.

Test reports for Hydrostatic Tests, Air Tests, Valve-Operating Tests, Drainage Tests, Pneumatic Tests, Non-Destructive Electric Tests and System Operation Tests shall be provided by the Contractor, in compliance with referenced standards contained within this section.

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-69, and AWS WHB-2.9.

Submit Installation Drawings for pipes, valves and specialties. Drawings shall include the manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Drawings shall specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

Connections between steel piping and copper piping shall be electrically isolated from each other with dielectric couplings (or unions) rated for the service.

Make final connections to equipment with unions provided every 100 feet of straight run. Provide unions in the line downstream of screwed- and welded-end valves.

Ream all pipe ends before joint connections are made.

Screwed joints shall be made up with specified joint compound and not more than three threads shall show after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Provide screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

3.2 VALVES

Provide valves in piping mains and all branches and at equipment where indicated and as specified.

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system.

Valves unavoidably located in furred or other normally inaccessible places shall be provided with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

3.3 SUPPORTING ELEMENTS INSTALLATION

Provide supporting elements in accordance with the referenced codes and standards.

Support piping from building structure. No piping shall be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Install piping support elements at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Load rating for all pipe-hanger supports shall be based on insulated weight of lines filled with water and forces imposed. Deflection per span shall not exceed slope gradient of pipe. Supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, the allowable span must be reduced proportionately:

PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	10	8

Provide vibration isolation supports where needed.

Vertical risers shall be supported independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers shall be guided for lateral stability. For risers subject to expansion, provide only one rigid support at a point approximately one-third down from the top. Place clamps under fittings unless otherwise specified. Support carbon-steel pipe at each floor and at not more than 15-footintervals for pipe 2 inches and smaller and at not more than 20-footintervals for pipe 2-1/2 inches and larger.

3.4 PENETRATIONS

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces shall include space above ceilings where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being

penetrated.

3.12 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Test data shall be clear and readily legible.

3.13 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.

3.13.1 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, design the factory painting system for the temperature service.

3.13.2 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 between120 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.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
08/09

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 INTERNATIONAL (AMCA)

AMCA 203	(1990) Field Performance Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002; 6th ed) National Standards for Total System Balance
AABC MN-4	(1996) Test and Balance Procedures

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV	(2006) Procedural Standards for Measurements of Sound and Vibration; 2nd Edition
NEBB PROCEDURAL STANDARDS	(2005) Procedural Standards for Testing, Adjusting and Balancing (TAB) of Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1143	(1985) HVAC Air Duct Leakage Test Manual, 1st Edition
SMACNA 1780	(2002) HVAC Systems - Testing, Adjusting and Balancing, 3rd Edition
SMACNA 1858	(2004) HVAC Sound And Vibration Manual - First Edition

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

40 CFR 82 Protection of Stratospheric Ozone

1.2 DEFINITIONS

a. AABC: Associated Air Balance Council.

b. COTR: Contracting Officer's Technical Representative.

c. DALT: Duct air leakage test

d. DALT'd: Duct air leakage tested

e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling.

f. NEBB: National Environmental Balancing Bureau

g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class.""a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by Appendix D REQUIREMENTS FOR DUCT AIR LEAK TESTING." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

i. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees Fahrenheit of the project site's summer outdoor design temperature, throughout the period of TAB data recording.

k. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).

l. TAB: Testing, adjusting, and balancing (of HVAC systems).

m. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.

n. TAB Agency: TAB Firm

o. TAB team field leader: TAB team field leader

p. TAB team supervisor: TAB team engineer.

q. TAB team technicians: TAB team assistants.

r. TABB: Testing Adjusting and Balancing Bureau.

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems	International Standards for Environmental Systems Balance
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.	Field Readiness Check & Prelim. Field Procedures

1.3 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of new heating, ventilating, and cooling (HVAC) air distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1143, except as supplemented and modified by this section. Conduct DALT and TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance systems (TAB) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.

2. Air quantities at air terminals.

3. Air quantities and temperatures in air handling unit schedules.

4. Water quantities and temperatures in thermal energy transfer equipment schedules.

5. Water quantities and heads in pump schedules.

6. Water flow measurement fittings and balancing fittings.

7. Ductwork Construction and Leakage Testing Table that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure. This table is included in the file for Graphics for Unified Facilities Guide Specifications: http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions, and systems readiness check. The TAB Specialist must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

Submit three copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field measurements.

1.3.4 Related Requirements

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Specific requirements relating to Reliability Centered Maintenance (RCM) principals and Predictive Testing and Inspection (PTI), by the construction contractor to detect latent manufacturing and installation defects must be followed as part of the Contractor's Quality Control program. Refer to the paragraph titled "Sustainability" for detailed requirements.

Requirements for price breakdown of HVAC TAB work are specified in Section 01 20 00.00 20 PRICE AND PAYMENT PROCEDURES.

Requirements for construction scheduling related to HVAC TAB work are specified in Section 01 32 17.00 20 NETWORK ANALYSIS SCHEDULES (NAS).

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Records of Existing Conditions; G

TAB Firm; G

Designation of TAB team assistants; G

Designation of TAB team engineer; G or TAB Specialist; G

Designation of TAB team field leader; G

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

SD-03 Product Data

Equipment and Performance Data; G

TAB Related HVAC Submittals; G

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer and assistant.

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G

Systems Readiness Check; G

TAB Execution; G

TAB Verification; G

SD-06 Test Reports

DALT and TAB Work Execution Schedule; G

DALT and TAB Procedures Summary; G

Design review report; G

Pre-Final DALT report; G

Final DALT report; G

TAB report

SD-07 Certificates

Independent TAB agency and personnel qualifications; G

Advance notice of Pre-Final DALT field work; G

Completed Pre-Final DALT Work Checklist; G

Advance Notice of TAB Field Work; G

Completed Pre-TAB Work Checklist

TAB Firm; G

Independent TAB Agency and Personnel Qualifications; G

DALT and TAB Submittal and Work Schedule; G

Design review report; G

Pre-field DALT preliminary notification; G

Pre-field TAB engineering report; G

Advanced notice for TAB field work; G

Prerequisite HVAC Work Check Out List ; G

1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or

certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.5.2 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.5.3 Sustainability

Contractor must submit the following as part of the Quality Control Plan for acceptance testing:

a. List all test equipment to be used, including its manufacturer,model number, calibration date, and serial number.

b. Certificates of test personnel qualifications and certifications. Provide certification of compliance with 40 CFR 82.

c. Proof of equivalency if the contractor desires to substitute a test requirement.

Perform the following PTI as an integral part of the TAB process per the most recent edition of the NASA RCBEA GUIDE:

HVAC Ducts:
a. Operational Test
b. Ductwork Leak Testing (DALT); Pre-Final DALT report, Final DALT report

Valves:

a. Hydrostatic Test

d. Infrared Thermography (optional)

1.5.4 Qualifications

1.5.4.1 TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications.

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor.

These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm must be a prime subcontractor of the Contractor and be financially and corporately independent of the mechanical subcontractor, reporting directly to and paid by the Contractor.

1.5.4.2 TAB Specialist

The TAB Specialist must be either a member of AABC,an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.5.4.3 TAB Specialist Responsibilities

TAB Specialist responsibilities include all TAB work specified herein and in related sections under his direct guidance. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist must participate in the commissioning process specified in Section 23 08 00.00 10 COMMISSIONING OF HVAC SYSTEMS.

1.5.4.4 TAB Related HVAC Submittals

The TAB Specialist must prepare a list of the submittals from the Contract

Submittal Register that relate to the successful accomplishment of all HVAC TAB. Accompany the submittals identified on this list with a letter of approval signed and dated by the TAB Specialist when submitted to the Government. Ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

1.5.5 Responsibilities

The Contractor is responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate TAB execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in paragraph entitled "TAB Submittal and Work Schedule."

1.5.5.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in paragraph entitled "TAB Personnel Qualification Requirements."

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:

   (1) Contract drawings and specifications

   (2) Approved submittal data for equipment

   (3) Construction work schedule

   (4) Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in paragraph entitled "TAB Submittal and Work Schedule," is met.

e. Coordination of supporting personnel:

   Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

   Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

   Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.

(1) HVAC system installations are fully complete.

(2) HVAC prerequisite checkout work lists specified in the paragraph "Pre-Field TAB Engineering Report" are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.

(3) DALT field checks for all systems are completed.

(4) HVAC system filters are clean for TAB field work.

i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.

j. Insulation work: For required DALT work , ensure that insulation is not installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.5.5.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of paragraph entitled "Independent TAB Agency Personnel Qualifications". The work to be performed by the TAB agency is limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the requirements of this specification section.

1.5.5.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Pre-DALT/TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence

and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the DALT or TAB field work.

e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the Contracting Officer.

f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.

h. Technical assistance for DALT work.

(1) Technical assistance: Provide immediate technical assistance to TAB field team.

(2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of one 8 hour workdays duration.

i. Final DALT report: Certify the DALT report. This certification includes the following work:

(1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.

(2) TAB Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.

j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

(1) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workdays duration. Review the TAB final report data and certify the TAB final report.

k. Certified TAB report: Certify the TAB report. This certification

includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.

m. TAB Field Check: The TAB team supervisor must attend and supervise TAB field check.

1.5.5.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.5.6 Test Reports

1.5.6.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1143. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.

b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition,provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration

date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.

d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5.6.2 Certified TAB Reports

Submit: TAB Report in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not 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 which the TAB data was recorded.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems.

(1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

(6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.and also at the following locations:

Main Duct: Take readings at four locations along the full length of the main duct, 25 percent, 50 percent, 75 percent, and 100 percent of the total duct length.

Branch Main Ducts: Take readings at branch main ducts.

e. Duct Traverses: Report duct traverses for main supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. 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.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

1.7 SEQUENCING AND SCHEDULING

1.7.1 DALT and TAB Submittal and Work Schedule

Comply with additional requirements specified in Appendix C: DALT AND TAB SUBMITTAL AND WORK SCHEDULE included at the end of this section

1.7.2 Projects with Phased Construction

This specification section is structured as though the HVAC construction, and thereby the TAB work, will be completed in a single phase. When the construction is completed in phases, the DALT work and TAB work must be planned, completed, and accepted for each construction phase.

1.7.2.1 Phasing of Work

This specification section is structured as though the HVAC construction, and thereby the TAB work, is going to be completed in a single phase. All elements of the TAB work are addressed on this premise. When a contract is to be completed in construction phases, including the TAB work, and the DALT work, the TAB work and DALT work must be planned for, completed and approved by the Contracting Officer with each phase. An example of this case would be one contract that requires the rehabilitation of the HVAC in each of several separated buildings. At the completion of the final phase, compile all approved reports and submit as one document.

1.7.3 DALT and TAB Submittal and Work Schedule

Submit this schedule,and TAB Schematic Drawings, adapted for this particular contract, to the Contracting Officer (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-DALT/TAB Meeting: Within 30 calendar days after the date of approval of the TAB agency and personnel, meet with the COTR.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design

review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, notify the Contracting Officer in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT Preliminary Notification, the COTR will select which of the project ductwork must be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report, schedule the COTR's DALT field check work with the Contracting Officer.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit TAB report.

Pre-Field TAB Engineering Report: Within 15 calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List and Advanced Notice For TAB Field Work: At a minimum of 115 calendar days prior to CCD, submit prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of TAB field work.

TAB Field Work: At a minimum of 90 calendar days prior to CCD, accomplish TAB field work; submit TAB report; and conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work .

1.7.3.1 Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

1.7.3.2 Pre-Field DALT Preliminary Notification

Notification: On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing within 7 calendar days after completion.

1.7.3.3 Pre-Field TAB Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

(1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

(2) Air System Diagrams: Use the contract drawings and duct fabrication drawings if available to provide air system diagrams in the report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagrams which identifies each outlet contained in the outlet airflow report sheets. Show intended locations of all traverses and static pressure readings.

(3) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

b. Pre-field data: Submit AABC or NEBB or SMACNA 1780 data report forms with the following pre-field information filled in:

(1) Design data obtained from system drawings, specifications, and approved submittals.

(2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

(3) Designate the actual data to be measured in the TAB field work.

(4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. Place the instrument key number in the blank space where the measured data would be entered.

c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted and approved by the Contracting Officer prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" must be provided for each separate system to be TAB'd.

1.8 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01 30 00.00 25 ADMINISTRATIVE REQUIREMENTS, stating that all contract requirements of this section must be accomplished directly by a first tier subcontractor. No work may be performed by a second tier subcontractor.

1.9 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period not less than 5 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB or DALT workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB firm. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB and DALT is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the TAB firm. The Contractor must also provide a 1 year contractor installation warranty.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section as specified in Appendix A WORK DESCRIPTIONS OF PARTICIPANTS.

3.2 PRE-DALT/TAB MEETING

Meet with the Contracting Officer's technical representative (COTR) to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 DALT PROCEDURES

3.3.1 Instruments, Consumables and Personnel

Provide instruments, consumables and personnel required to accomplish the DALT field work. Follow the same basic procedure specified below for TAB Field Work, including maintenance and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Advance Notice of Pre-Final DALT Field Work

On completion of the installation of each duct system indicated to be

DALT'd, notify the Contracting Officer in writing prior to the COTR's duct selection field visit.

3.3.3 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the COTR will randomly select sections of each completed duct system for testing by the Contractor's TAB Firm. The sections selected will not exceed 20 percent of the total measured linear footage of duct systems indicated as subject to DALT. Sections of duct systems subject to DALT will include 20 percent of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, and plenum ductwork.

It is acceptable for an entire duct system to be DALT'd instead of disassembling that system in order to DALT only the 20 percent portion specified above.

3.3.4 DALT Testing

Perform DALT on the HVAC duct sections of each system as selected by the COTR. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1143.

In spite of specifications of SMACNA 1143 to the contrary, DALT ductwork of construction class of 3-inch water gauge static pressure and below if indicated to be DALT'd. Complete DALT work on the COTR selected ductwork within 48 hours after the particular ductwork was selected for DALT. Separately conduct DALT work for large duct systems to enable the DALT work to be completed in 48 hours.

3.3.5 Pre-final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report meeting the additional requirements specified in Appendix B REPORTS - DALT and TAB. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the Pre-final DALT report shall provide the basis for the Final DALT Report.

TAB supervisor shall review, approve and sign the Pre-Final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COTR that the field check of the Pre-Final DALT Report data can commence.
After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. TAB team to furnish data required by those data report forms . Prepare the report neatly and legibly; the Pre-final DALT report is the basis for the Final DALT Report. TAB supervisor must review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COTR that the field check of the Pre-final DALT Report data can commence.

3.3.6 Quality Assurance - COTR DALT Field Acceptance Testing

In the presence of the COTR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COTR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT'd.

Further, if any data on the Pre-final DALT report form for a given duct

section is out-of-tolerance, then field acceptance testing shall be conducted on data for one additional duct section, preferably in the same duct system, in the presence of the COTR.

3.3.7 Additional COTR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the COTR.

3.3.8 Certified Final DALT Report
On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TAB Supervisor is to assemble, review, certify and submit the Final DALT Report to the Contracting Officer for approval.

On successful completion of all field checks of the Pre-Final DALT Report data for all systems, the TAB Supervisor shall assemble, review, approve, sign and submit the Final DALT Report in compliance with Appendix B REPORTS - DALT and TAB to the Contracting Officer for approval.

3.3.9 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.

3.4 TAB PROCEDURES

3.4.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

That is, comply with the the requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) and SMACNA 1858 (TABB),except as supplemented and modified by this section.

Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section. The only water flow and air flow reporting which can be deferred until the Season 2 is that data which would be affected in terms of accuracy due to outside ambient conditions.

3.4.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in

the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.4.3 TAB Air Distribution Systems

3.4.3.1 Units With Coils

Report heating and cooling performance capacity tests for hot water, chilled water, DX and steam coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

   Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

   Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.3.2 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.4.8 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

3.4.9 Deficiencies

Strive to meet the intent of this section to maximize the performance of

the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.4.10 TAB Reports

Additional requirements for TAB Reports are specified in Appendix B REPORTS - DALT and TAB
After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

After completion of the TAB work, prepare a pre-final TAB report using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship" of this section.

Prepare the report neatly and legibly; the pre-final TAB report is the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the COTR that the field check of the TAB report data can commence; give this verbal notice 48 hours in advance of field check commencement. Do not schedule field check of the TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the Contracting Officer.

3.4.11 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.11.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COTR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All air handling units.

Group 3: 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COTR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

3.4.11.2 Additional COTR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COTR.
Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.4.11.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final Contracting Officer approval of the TAB Report submitted.

3.5 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.6 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

3.7 APPENDICES

Appendix A WORK DESCRIPTIONS OF PARTICIPANTS
Appendix B REPORTS - DALT and TAB
Appendix C DALT AND TAB SUBMITTAL AND WORK SCHEDULE
Appendix D REQUIREMENTS FOR DUCT AIR LEAK TESTING

Appendix A

WORK DESCRIPTIONS OF PARTICIPANTS

The Contractor is responsible for ensuring compliance with all requirements of this specification section. However, the following delineation of specific work items is provided to facilitate and co-ordinate execution of the various work efforts by personnel from separate organizations.

1. Contractor

a. HVAC documentation: Provide pertinent contract documentation to the TAB Firm, to include the following: the contract drawings and specifications; copies of the approved submittal data for all HVAC equipment, air distribution devices, and air/water measuring/balancing devices; the construction work schedule; and other applicable documents requested by the TAB Firm. Provide the TAB Firm copies of contract revisions and modifications as they occur.

b. Schedules: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.

c. Pre-DALT and TAB meeting: Arrange and conduct the Pre-DALT and TAB meeting. Ensure that a representative is present for the sheet metal contractor, the mechanical contractor, the electrical contractor, and the automatic temperature controls contractor.

d. Coordinate Support: Provide and coordinate support personnel required by the TAB Firm in order to accomplish the DALT and TAB field work. Support personnel may include factory representatives, HVAC controls installers, HVAC equipment mechanics, sheet metal workers, pipe fitters, and insulators. Ensure support personnel are present at the work site at the times required.

e. Correct Deficiencies: Ensure the notifications of Construction Deficiencies are provided as specified herein. Refer to the paragraph entitled "Construction Deficiencies." Correct each deficiency as soon as practical with the Contracting Officer, and submit revised schedules and other required documentation.

f. Pre-TAB Work Checklists: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as pre-TAB work checklist items, the deficiencies pointed out by the TAB team supervisor in the design review report.

   Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's DALT and TAB Work Procedures Summary. Do not allow the TAB team to commence TAB field work until all of the following are completed.

g. Give Notice of Testing: Submit advance notice of TAB field work accompanied by completed prerequisite HVAC Work List

h. Insulation work: Ensure that no insulation is shall not be installed

on ducts to be DALT'd until DALT work on the subject ducts is complete.

Ensure the duct and piping systems are properly insulated and vapor sealed upon the successful completion and acceptance of the DALT and TAB work.

2. TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Schedule: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.

c. Submittals: Provide the submittals specified herein.

d. Pre-DALT/TAB meeting: Attend meeting with Contractor. Ensure TAB personnel that will be involved in the TAB work under this contract attend the meeting.

e. Design Review Report: Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

f. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the DALT and TAB Procedures Summary, the during the DALT or TAB field work.

Ensure the Contractor is properly notified and aware of all support personnel needed to perform the TAB work. Maintain communication with the Contractor regarding support personnel throughout the duration of the TAB field work, including the TAB field acceptance testing checking.

Ensure all inspections and verifications for the Pre-Final DALT and Pre-TAB Checklists are completely and successfully conducted before DALT and TAB field work is performed.

g. Advance Notice: Monitor the completion of the duct system installations and provide the Advance Notice for Pre-Final DALT field work as specified herein.

h. Technical Assistance: Provide technical assistance to the DALT and TAB field work.

i. Deficiencies Notification: Ensure the notifications of Construction Deficiencies are provided as specified herein. Comply with requirements of the paragraph entitled "Construction Deficiencies." Resolve each deficiency as soon as practical and submit revised schedules and other required documentation.

j. Procedures: Develop the required TAB procedures for systems or system

components not covered in the TAB Standard.

3. TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC work list, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

Appendix B

REPORTS - DALT and TAB

All submitted documentation must be typed, neat, and organized. All reports must have a waterproof front and back cover, a title page, a certification page, sequentially numbered pages throughout, and a table of contents. Tables, lists, and diagrams must be titled. Generate and submit for approval the following documentation:

1. DALT and TAB Work Execution Schedule

Submit a detailed schedule indicating the anticipated calendar date for each submittal and each portion of work required under this section. For each work entry, indicate the support personnel (such as controls provider, HVAC mechanic, etc.) that are needed to accomplish the work. Arrange schedule entries chronologically.

2. DALT and TAB Procedures Summary

Submit a detailed narrative describing all aspects of the DALT and TAB field work to be performed. Clearly distinguish between DALT information and TAB information. Include the following:

a. A list of the intended procedural steps for the DALT and TAB field work from start to finish. Indicate how each type of data measurement will be obtained. Include what Contractor support personnel are required for each step, and the tasks they need to perform.

b. A list of the project's submittals that are needed by the TAB Firm in order to meet this Contract's requirements.

c. The schematic drawings to be used in the required reports, which may include building floor plans, mechanical room plans, duct system plans, and equipment elevations. Indicate intended TAB measurement locations, including where test ports need to be provided by the Contractor.

d. The data presentation forms to be used in the report, with the preliminary information and initial design values filled in.

e. A list of DALT and TAB instruments to be used, edited for this project, to include the instrument name and description, manufacturer, model number, scale range, published accuracy, most recent calibration date, and what the instrument will be used for on this project.

f. A thorough checklist of the work items and inspections that need to be accomplished before DALT field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-Final DALT Work Checklist before DALT field work can be accomplished.

g. A thorough checklist of the work items and inspections that need to be accomplished before the TAB field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-TAB Work Checklist before the TAB field work can be accomplished.

i. The checklists specified above shall be individually developed and tailored specifically for the work under this contract. Refer to

NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under the paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" for examples of items to include in the checklists.

3. Design Review Report

Submit report containing the following information:

a. Review the contract specifications and drawings to verify that the TAB work can be successfully accomplished in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

b. Submit a typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the DALT work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. If no deficiencies are evident, state so in the report.

4. Pre-Final DALT Report for COTR DALT Field Checks

Report the data for the Pre-Final DALT Report meeting the following requirements:

a. Submit a copy of the approved DALT and TAB Procedures Summary: Provide notations describing how actual field procedures differed from the procedures listed.

b. Report format: Submit a comprehensive report for the DALT field work data using data presentation forms equivalent to the "Air Duct Leakage Test Summary Report Forms" located in the SMACNA 1143. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Node numbers shall be included in the completed report forms to identify each duct section.

c. Calculations: Include a copy of all calculations prepared in determining the duct surface area of each duct test section. Include in the DALT reports copy(s) of the calibration curve for each of the DALT test orifices used for testing.

d. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments are to be calibrated within one year of the date of use in the field; instrument calibration is to be traceable to the measuring standards of the National Institute of Standards and Technology.

d. TAB Supervisor Approval: Include on the submitted report the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

5. Final DALT Report

On successful completion of all COTR field checks of the Pre-final DALT Report data for all systems, the TABS Supervisor shall assemble, review, sign and submit the Final DALT Report to the Contracting Officer for approval.

6. TAB Reports: Submit TAB Report in the following manner:

a. Procedure Summary: Submit a copy of the approved DALT and TAB Procedures Summary. When applicable, provide notations describing how actual field procedures differed from the procedures listed.

b. Report format: Submit the completed data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed, approved and signed by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

c. 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 which the TAB data was recorded.

(1) Data shall be measured and compiled on a continuous basis for the period in which TAB work affecting those rooms is being done.

(2) Data shall be measured/recorded only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode. Provide a detailed explanation wherever a final measurement did not achieve the required value.

(3) Data may be compiled using direct digital controls trend logging where available. Otherwise, the Contractor shall temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls shall have been fully operational a minimum of 24 hours in advance of commencing data compilation. The specified data shall be included in the TAB Report.

d. Air System Diagrams: Provided updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations.

e. Air Static Pressure Profiles: Report static pressure profiles for air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. The static pressure report data shall include, in addition to AABC or NEBB or TABB required data, the following:

(1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across chilled water coils, DX coils, hot water coils, steam coils, electric resistance heating coils and heat reclaim devices installed in unit cabinetry or the system ductwork.

(3) Report static pressure drop across outside air, return air, and

supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

(4) Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

(5) Report static pressure drop across outside air and relief/exhaust air louvers.

(6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.

f. Duct Transverses: Report duct traverses for main and branch main supply, return, exhaust, relief and outside air ducts. This shall include all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency shall evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pitot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane".

g. 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.

Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

h. Performance Curves: The TAB Supervisor shall include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor shall include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturis and flow orifices TAB'd on the job.

j. Data From TAB Field Work: After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and approval signature, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB

report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

Appendix C

DALT AND TAB SUBMITTAL AND WORK SCHEDULE

Perform the following items of work in the order listed adhering to the dates schedule specified below. Include the major items listed in this schedule in the project network analysis schedule required by Section 01 32 17.00 20 NETWORK ANALYSIS SCHEDULES (NAS).

Submit TAB Agency and TAB Personnel Qualifications: Within 42 calendar days after date of contract award.

Submit the DALT and TAB Work Execution Schedule: within 14 days after receipt of the TAB agency and TAB personnel qualifications approval. Revise and re-submit this schedule 28 days prior to commencement of DALT work and 28 days prior to the commencement of TAB Season 1 work and TAB Season 2 work.

Submit the DALT and TAB Work Procedures Summary: within 14 days after receipt of the initial approved DALT and TAB Work Execution Schedule.

Meet with the COTR at the Pre-DALT/TAB Meeting: Within 28 calendar days after receipt of the approved initial DALT/TAB Execution Schedule.

Submit Design Review Report: Within 56 calendar days after the receipt of the approved initial DALT and TAB Work Execution Schedule.

Advance Notice of Pre-Final DALT Field Work: After the completed installation of the HVAC duct system to be DALT'd, submit to the Contracting Officer an Advance Notice of Pre-Final DALT Field Work accompanied by the completed Pre-Final DALT Work Checklistchecklist for the subject duct system.

Ductwork Selected for DALT: Within 14 calendar days after receiving an acceptable completed Pre-Final DALT Work Checklist, the Contracting Officer's technical representative (COTR) will select the project ductwork sections to be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected project ductwork.

Submit Pre-Final DALT Report: Within two working days after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

Quality Assurance - COTR DALT Field Checks: Upon approval of the Pre-final DALT Report, the COTR's DALT field check work shall be scheduled with the Contracting Officer.

Submit Final DALT Report: Within 14 calendar days after completion of successful DALT Work Field Check, submit Season 1 TAB report.

Advance Notice of TAB Field Work: At a minimum of 14 calendar days prior to TAB Field Work, submit advance notice of TAB field work accompanied by completed
Pre-TAB Work Checklist.

TAB Field Work: At a minimum of 84 calendar days prior to CCD, accomplish TAB field work.

Submit TAB Report: Within 14 calendar days after completion of TAB field work, submit initial TAB report.

Quality Assurance - COTR TAB Field Check: 30 calendar days after initial TAB report is approved by the Contracting Officer, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work and submit final.

Receive the approved TAB report: Within 21 calendar days, receive the report from Contracting Officer approved TAB report.

Appendix D

REQUIREMENTS FOR DUCT AIR LEAK TESTING

	SYSTEMS
	AHU Unit No. 1
Duct System Static Pressure in inches W.C.	
for Supply.....	2
for Return.....	1
for Exhaust.....	0.5
for Outside Air..	1
System Oval/Round Duct and Rectangular Duct SMACNA Seal Class	
for Supply.....	A
for Return.....	A
for Exhaust.....	A
for Outside Air...	A
Duct Test Pressure in inches W.C.	
for Supply.....	2
for Return.....	1
for Exhaust.....	0.5
for Outside Air..	1

-- End of Section --

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS
08/10

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 within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2007; Supplement 2008; Addenda r 2009) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 240/A 240M	(2010) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 580/A 580M	(2008) Standard Specification for Stainless Steel Wire
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 1126	(2004) Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	(2010) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	(2006e1) Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C 1427	(2007; E 2010) Specification for Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form

ASTM C 195	(2007) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C 449	(2007) Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 534/C 534M	(2008) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(2007e1) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C 552	(2007) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 553	(2008) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 591	(2009) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2010) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(2008) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 665	(2006) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 795	(2008) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 916	(1985; R 2007) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C 920	(2010) Standard Specification for Elastomeric Joint Sealants
ASTM C 921	(2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 774/D 774M	(1997; R 2007) Bursting Strength of Paper
ASTM D 882	(2010) Tensile Properties of Thin Plastic Sheeting
ASTM E 2231	(2009) Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

ASTM E 84	(2010) 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

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(2003) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(1999) National Commercial & Industrial Insulation Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 255	(2006) Standard Method of Test of Surface Burning Characteristics of Building Materials
NFPA 90A	(2009; Errata 09-1) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B	(2009) Standard for the Installation of Warm Air Heating and Air Conditioning Systems

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-24179	(1987; Rev A; Am 2) Adhesive, Flexible Unicellular-Plastic Thermal Insulation
MIL-A-3316	(1990; Rev C; Am 2) Adhesives, Fire-Resistant, Thermal Insulation

UNDERWRITERS LABORATORIES (UL)

UL 723	(2008) Test for Surface Burning Characteristics of Building Materials

1.2 SYSTEM DESCRIPTION

1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.2.2 Surface Burning Characteristics

Unless otherwise specified, insulation shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84, NFPA 255 or UL 723. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Test specimens shall be prepared and mounted according to ASTM E 2231. Insulation materials located exterior to the building perimeter are not required to be fire rated.

1.2.3 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meets all other requirements of this section. The minimum recycled material content of the following insulation are:

Rock Wool - 75 percent slag of weight
Fiberglass - 20-25 percent glass cullet by weight
Rigid Foam - 9 percent recovered material

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

MICA Plates; G
Pipe Insulation Systems and Associated Accessories
Duct Insulation Systems and Associated Accessories
Equipment Insulation Systems and Associated Accessories

A booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.

a. The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates

shall present all variations of insulation systems including locations, materials, vaporproofing, jackets and insulation accessories.

b. If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.

SD-03 Product Data

Certification
Pipe Insulation Systems; G
Duct Insulation Systems; G
Equipment Insulation Systems; G

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copywrited, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section of the specification shall be submitted together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable.

SD-04 Samples

Thermal Insulation; G

After approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements, shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

Duct Insulation Display Sections: Display sample sections for rigid and flexible duct insulation used on the job. A temporary

covering shall be used to enclose and protect display sections for duct insulation exposed to weather.

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G
Duct Insulation Systems; G
Equipment Insulation Systems; G

Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the submitted MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. The instructions must be copywrited, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation.

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.4.2 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material. Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide 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 systems. Insulation shall be CFC and HCFC free.

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.1 - IP. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Calcium silicate shall not be used on chilled or cold water systesm. Materials shall be asbestos free and conform to the following:Flexible Elastomeric: Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive. Comply with ASTM C 534/C 534M, Type I, Grade 1, for tubularmaterials and Type II, Grade 1, for sheet materials. Provide product recognized under Underwriters Laboratories "UL 94 - Plastic Component Classification" and listed in Factory Mutual "FM Approval Guide."

2.2.1 Adhesives

2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Adhesive shall be MIL-A-3316, Class 1, pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.2 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any

heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product recognized under Underwriters Laboratories "UL 94 - Plastic Component Classification" and listed in Factory Mutual "FM Approval Guide."

2.2.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.2.4 Corner Angles

2.2.4.1 General

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

2.2.4.2 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor).

2.2.5 Finishing Cement

ASTM C 449: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C 795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel.

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the

Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.8.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plys standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E 96/E 96M; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent WVT.

2.2.9 Vapor Retarder Required

ASTM C 921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, polyisocyanurate, and phenolic foam. Insulation materials that do not require jacketing are flexible elastomerics. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

Standard reinforced fire retardant jacket for use on hot/cold pipes, ducts, or equipment. Vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

a. The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plys standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Less than 0.02 permeability when tested in accordance with ASTM E 96/E 96M. Meeting UL 723 or ASTM E 84 flame and smoke requirements; UV resistant.

b. The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96/E 96M utilizing apparatus described in ASTM E 96/E 96M. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent WVT.

2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D 882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

2.2.9.6 Vapor Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E 96/E 96M). Vapor barrier shall meet UL 723 or ASTM E 84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with ASTM D 774/D 774M. Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.2.10 Vapor Retarder Not Required

ASTM C 921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.11 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.13 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.3 PIPE INSULATION SYSTEMS

Insulation materials shall conform to Table 1. Insulation thickness shall be as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1 - IP. Insulation thickness shall be 1inch minimum. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

b. Flexible Elastomeric Cellular Insulation: ASTM C 534/C 534M, Grade 1, Type I or II. Type II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation.

c. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

d. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory-applied vapor retarder/vapor barrier. Insulation with pre-applied adhesive shall not be used.

e. Flexible Polyolefin Cellular Insulation: ASTM C 1427, Grade 1 Type I or II.

f. Mineral Fiber Insulation with Integral Wicking Material (MFIWM): ASTM C 547. Install in accordance with manufacturer's instructions.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Duct Insulation

Provide factory applied elastomeric closed cell or phenolic foam insulation according to manufacturer's recommendations for insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier.

2.4.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C 612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf average, 1-1/2 inch thick, Type IA, IB, II, III, and IV.

2.4.1.2 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3, 3/4 pcf nominal, 2.0 inches thick or Type II up to 250 degrees F. Also ASTM C 1290 Type III may be used.

2.4.4 Duct Insulation Jackets

2.4.4.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2.4.4.2 Metal Jackets

a. Aluminum Jackets: ASTM B 209, Temper H14, minimum thickness of 27 gauge (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 1/2 inch.

b. Stainless Steel Jackets: ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 33 gauge (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.4.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 4 and 5. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end

of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and/or NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items, as specified.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified

otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. An aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

c. Where pipes penetrate interior walls, the aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plys standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The

flashing and counter flashing shall be sealed underneath with caulking.

h. For hot water pipes supplying lavatories or other similar heated service that requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. The annular space between the pipe and wall penetration shall be caulked with approved fire stop material. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

i. For domestic cold water pipes supplying lavatories or other similar cooling service that requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and the wall penetration shall be caulked with an approved fire stop material having vapor retarder properties. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

b. Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, prefabicated insulation pipe hangers, perlite above 80 degrees F), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

c. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the

insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

d. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Grade 1, Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, stainless steel, aluminum or flexible laminate cladding (comprised of elastomeric, plastic or metal foil laminate) laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket, - less than 0.0000 permeability; (greater than 3 ply, standard grade, silver, white, black and embossed) jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.1.6 Pipe Insulation Material and Thickness

TABLE 1
Insulation Material For Piping (°F)

Service	Material	Spec-Type-Class		Vapor Retard/ Vapor Barr'r Required
Refrigerant Suction Piping (35°F nominal)	Flex Elast Cell'r	ASTM C 534/C 534M	I	No
	Cellular Glass	ASTM C 552	II 1	Yes
	Faced Phenol Foam	ASTM C 1126	III	Yes
	Polyisocianurate	ASTM C 591	I	Yes
A/C condensate Drain Located Inside Bldg.	Polyisocianurate	ASTM C 591	I	Yes
	Cellular Glass	ASTM C 552	II 2	No
	Flex Elast Cell'r	ASTM C 534/C 534M	I	No
	Faced Phenol Foam	ASTM C 1126	II	Yes

TABLE 2
Piping Insulation Thickness (inch and °F)

Service	Material	Tube And Pipe Size (Inches) <1	1- <1.5	1.5- <4	4- <8	>or = to 8
Refrigerant Suction Piping (35°F nominal)	Flex Elas Cell'r	0.5	0.5	1	N/A	N/A
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Faced Phenol Foam	1	1	1	1	1
	Polyisocianurate	1	1	1	1	1
A/C condensate Drain Located Inside Bldg.	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flex Elas Cell'r	1	1	1	N/A	N/A
	Faced Phenol Foam	1	1	1	1	1

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Refrigerant suction lines.

b. Air conditioner condensate drains.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe. Insulation inside the building, to be protected with an aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, white & black, shall be provided for pipe insulation to the 6 ft level.

3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. If staples are used, they shall be sealed in accordance with item "e." below. Note that staples are not required with cellular glass systems.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. The patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

h. Installation of flexible elastomeric cellular pipe insulation shall be by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Grade 1, Type II sheet insulation when used on pipe larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC

fitting covers shall be protected with PVDC or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with either greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape, standard grade, silver, white, black and embossed or PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping

above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)

Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Plenums.

c. Coil headers and return bends.

d. Coil casings.

e. Fresh air intake ducts.

f. Filter boxes.

g. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.

b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Joints in the insulation jacket shall be sealed with a 4 inch wide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts.

c. Fresh air intake ducts.

d. Filter boxes.

e. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, and rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from

the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.

d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Install equipment insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Hand-holes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

f. Duct Test/Balance Test Holes.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

a. Refrigeration equipment parts that are not factory insulated.

b. Drip pans under chilled equipment.

c. Air handling equipment parts that are not factory insulated.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Material and thicknesses shall be as shown in Table 5:

Legend

RMF: Rigid Mineral Fiber
FMF: Flexible Mineral Fiber
CS: Calcium Silicate
PL: Perlite
CG: Cellular Glass
FC: Flexible Elastomeric Cellular
PF: Phenolic Foam
PC: Polyisocyanurate Foam
PE: Polyolefin closed cell

TABLE 5
Insulation Thickness for Cold Equipment (Inches and °F)

Equipment handling media at indicated temperature:	Material	Thickness
35 to 60 degrees F	CG	1.5 inches
	PF	1.5 inches
	FC	1.0 inches
	PC	1.0 inches
	PE	1.0 inches
1 to 34 degrees F	PC	1.5 inches
	FC	1.5 inches
	CG	3.0 inches
	PF	1.5 inches
	PE	1.5 inches
Minus 30 to 0 degrees F	PC	1.5 inches
	FC	1.75 inches
	CG	3.5 inches
	PF	1.5 inches
	PE	1.5 inches

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered with contact adhesive. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Phenolic foam insulation shall be set in a coating of bedding compound and joints shall be sealed with bedding compound as recommended by the manufacturer. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.

d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.

e. Exposed insulation corners shall be protected with corner angles.

f. Insulation on equipment with ribs shall be applied over 6 by 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inches washers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder/Vapor Barrier

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating or vapor barrier jacket shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking or vapor barrier tape shall be applied to parting line between equipment and removable section insulation.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.5.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a

manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 08 00.00 10

COMMISSIONING OF HVAC SYSTEMS
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.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline	(2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard	(2009) Procedural Standards for Whole Building Systems Commissioning of New Construction; 3rd Edition

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1429	(1994) HVAC Systems Commissioning Manual, 1st Edition

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

In some instances, terminology differs between the Contract and the Commissioning Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding ACG, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS

Contract Term	ACG	NEBB	TABB
Commissioning Standard	ACG Commissioning Guideline	Procedural Standards for Building Systems Commissioning	SMACNA HVAC Commissioning Guideline
Commissioning Specialist	ACG Certified Commissioning	NEBB Qualified Commissioning	TABB Certified Commissioning

SIMILAR TERMS

Agent	Administrator	Supervisor

1.3 SYSTEM DESCRIPTION

1.3.1 General

Perform Commissioning in accordance with the requirements of the standard under which the Commissioning Firm's qualifications are approved, i.e., ACG Commissioning Guideline, NEBB Commissioning Standard, or SMACNA 1429 unless otherwise stated herein. Consider mandatory all recommendations and suggested practices contained in the Commissioning Standard. Use the Commissioning Standard for all aspects of Commissioning, including qualifications for the Commissioning Firm and Specialist and calibration of Commissioning instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the Commissioning Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the Commissioning Standard, Commissioning procedures shall be developed by the Commissioning Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.3.2 Energy

Formal LEED certification is not required; however, the Contractor is required to provide documentation that meets the LEED Energy & Atmosphere (EA) Prerequisite 1, Fundamental Commissioning. For New Construction and Major Revisions provide, also, documentation that meets EA Credit 3; Enhanced Commissioning. Provide documentation for as many LEED credits as possible to support LEED Silver certification of the project.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Commissioning Plan; G,

Commissioning Plan prepared in accordance with Commissioning Standard, no later than 28 days after the approval of the Commissioning Specialist.

SD-03 Product Data

Pre-Functional Performance Test Checklists; G,

At least 28 days prior to the start of Pre-Functional Performance Test Checks. Submit the schedule for the test checks at least 14 days prior to the start of Pre-Functional Performance Test Checks.

Functional Performance Tests; G,

Test procedures at least 28 days prior to the start of Functional Performance Tests. The schedule for the tests at least 14 days prior to the start of Functional Performance Tests.

SD-06 Test Reports

Commissioning Report; G

No later than 14 days after completion of Functional Performance Tests.

SD-07 Certificates

Commissioning Firm; G

Certification of the proposed Commissioning Firm's qualifications by one of the following ACG, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. Include in the documentation the date that the Certification was initially granted and the date when the current Certification expires. Any lapses in Certification of the proposed Commissioning Firm or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Firm shall be described in detail.

Commissioning Specialist; G

Certification of the proposed Commissioning Specialist's qualifications by one of the following ACG, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date when the current Certification expires. Any lapses in Certification of the proposed Commissioning Specialist or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Specialist shall be described in detail.

1.5 QUALITY ASSURANCE

1.5.1 Commissioning Firm

Provide a Commissioning Firm that is either a member of ACG or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Firm for approval. Any firm that has been the subject of disciplinary action by the ACG, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including Commissioning. All work specified in this Section and in other related Sections to be performed by the Commissioning Firm shall be considered invalid if the Commissioning Firm loses its certification prior to Contract completion and must be performed by an approved successor. These Commissioning services are to assist the

prime Contractor in performing the quality oversight for which it is responsible. The Commissioning Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of all other subContractors. The Commissioning Firm shall report to and be paid by the prime Contractor.

1.5.2 Commissioning Specialist

1.5.2.1 General

The Commissioning Specialist shall be an ACG Certified Commissioning Agent, a NEBB Qualified Commissioning Administrator, or a TABB Certified Commissioning Supervisor and shall be an employee of the approved Commissioning Firm. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Commissioning Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Specialist for approval. Any individual that has been the subject of disciplinary action by the ACG, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including Commissioning. All work specified in this Section and in other related Sections performed by the Commissioning Specialist shall be considered invalid if the Commissioning Specialist loses his certification prior to Contract completion and must be performed by the approved successor.

1.5.2.2 Responsibilities

Perform all Commissioning work specified herein and in related sections under the direct guidance of the Commissioning Specialist. The Commissioning Specialist shall prepare the Commissioning Plan, which will be a comprehensive schedule and will include all submittal requirements for procedures, notifications, reports and the Commissioning Report. After approval of the Commissioning Plan, revise the Contract NAS schedule to reflect the schedule requirements in the Commissioning Plan.

1.6 SEQUENCING AND SCHEDULING

Begin the work described in this Section only after all work required in related Sections has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved. Pre-Functional Performance Test Checklists shall be performed at appropriate times during the construction phase of the Contract.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND TEST FORMS AND CHECKLISTS

Designate Contractor team members to participate in the Pre- Functional Performance Test Checklists and the Functional Performance Tests specified herein. In addition, the Government team members will include a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency's Representative. The team members shall be as follows:

Designation	Function

A Contractor's Commissioning Specialist
M Contractor's Mechanical Representative
E Contractor's Electrical Representative
T Contractor's Testing, Adjusting, and Balancing (TAB) Specialist
C Contractor's Controls Representative
D Design Agency Representative
O Contracting Officer's Representative
U Using Agency's Representative

Appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each Pre- Functional Performance Test Checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test item shall be indicated by signature and date.

3.2 TESTS

Perform the pre-functional performance test checklists and functional performance tests in a manner that essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, establish methods which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. Provide all materials, services, and labor required to perform the pre- functional performance tests checks and functional performance tests. A functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test.

3.2.1 Pre-Functional Performance Test Checklists

Perform Pre-Functional Performance Test Checklists for the items indicated in Appendix A. Correct and re-inspect deficiencies discovered during these checks in accordance with the applicable contract requirements.

3.2.2 Functional Performance Tests

Perform Functional Performance Tests for the items indicated in Appendix B. Begin Functional Performance Tests only after all Pre-Functional Performance Test Checklists have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Begin Tests with equipment or components and progress through subsystems to complete systems. Upon failure of any Functional Performance Test item, correct all deficiencies in accordance with the applicable contract requirements. The item shall then be retested until it has been completed with no errors.

3.3 COMMISSIONING REPORT

The Commissioning Report shall consist of completed Pre- Functional Performance Test Checklists and completed Functional Performance Tests organized by system and by subsystem and submitted as one package. The Commissioning Report shall also include all HVAC systems test reports,

inspection reports (Preparatory, Initial and Follow-up inspections), start-up reports, TAB report, TAB verification report, Controls start-up test reports and Controls Performance Verification Test (PVT) report. The results of failed tests shall be included along with a description of the corrective action taken.

APPENDIX A

PRE-FUNCTIONAL PERFORMANCE TEST CHECKLISTS

Pre-Functional Performance Test Checklist - DX Air Cooled Condensing Unit

For Condensing Unit: CU1

Checklist Item	A	M	E	T	C	O
Installation						
a. Check condenser fans for proper rotation.	___	___	X	___	X	___
Electrical	A	M	E	T	C	O
a. Power available to unit disconnect.	___	X	___	X	X	___
b. Power available to unit control panel.	___	X	___	X	___	___
c. Verify that power disconnect is located within sight of the unit it controls	___	X	___	X	___	___
Controls	A	M	E	T	C	O
a. Unit safety/protection devices tested.	___	___	X	X	___	___
b. Control system and interlocks installed.	___	___	X	X	___	___
c. Control system and interlocks operational.	___	___	X	X	___	___

Pre-Functional Performance Test Checklist - Fan Coil Unit

For Fan Coil Unit: DFFC-1&2

Checklist Item						
Installation	A	M	E	T	C	O
a. Access doors/removable panels are operable and sealed.	___	___	X	___	X	___
b. Condensate drainage is unobstructed.	___	___	X	X	X	___
c. Fan belt adjusted.	___	___	X	___	X	___
Electrical	A	M	E	T	C	O
a. Power available to unit disconnect.	___	___	___	X	___	___
b. Power available to unit control panel.	___	___	___	X	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___

d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___
e. Power available to electric heating coil.	___	___	___	X	X	___

Coils	A	M	E	T	C	O
a. Refrigerant piping properly connected.	___	___	X	X	X	___

Controls	A	M	E	T	C	O
a. Control valves/actuators properly installed.	___	___	X	___	___	___
b. Control valves/actuators operable.	___	___	X	X	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___

Testing, Adjusting, and Balancing (TAB)	A	M	E	T	C	O
a. TAB Report approved.	___	___	X	___	X	___

Pre-Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: AHU-1

Checklist Item

Installation	A	M	E	T	C	O
a. Inspection and access doors are operable and sealed.	___	___	X	___	X	___
b. Condensate drainage is unobstructed.	___	___	X	X	X	___
c. Fan belt adjusted.	___	___	X	___	X	___

Electrical	A	M	E	T	C	O
a. Power available to unit disconnect.	___	___	___	X	X	___
b. Power available to unit control panel.	___	___	___	X	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___
e. Power available to electric heating coil.	___	___	___	X	___	___

Coils	A	M	E	T	C	O
a. Refrigerant piping properly connected.	___	___	X	X	X	___

Controls	A	M	E	T	C	O
a. Control valves/actuators properly installed.	___	___	X	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___

Testing, Adjusting, and Balancing (TAB)	A	M	E	T	C	O
a. TAB Report approved.	___	___	X	___	X	___

- End of Appendix A -

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: _____

1. Functional Performance Test: Contractor shall verify operation of air handling unit in accordance with specification including the following:

a. Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

a. The following shall be verified when the supply fan operating supply and return fans operating mode is initiated:

(1) All dampers in normal position prior to fan start_____.

(2) All valves in normal position prior to fan start_____.

(3) System safeties allow start if safety conditions are met. ___

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position._____

(2) Return air damper open._____

(1) Outside air damper modulated to maintain mixed air temperature set point. Setpoint _____deg F Actual _____deg F O/A damper position _____% Return Air Temperature_____deg F Outside Air Temperature _____ deg F

(2) Relief air damper modulates with outside air damper according to sequence of operation. Relief air damper position _____%

d. Unoccupied mode of operation.

(1) Observe fan starts when space temperature calls for heating/cooling ____.

(2) All dampers in normal position. _____

(3) Verify low limit space temperature is maintained as specified in sequence of operation. _____

Functional Performance Test Checklist (cont) - Single Zone Air Handling Unit

e. The following shall be verified when the supply fan off supply and return fans off mode is initiated:

(1) All dampers in normal position._____

(2) All valves in normal position._____

(3) Fan de-energizes. _____

f. Verify cooling coil and heating coil operation by varying thermostat set point from cooling set point to heating set point and returning to cooling set point_____.

g. Verify safety shut down initiated by low temperature protection thermostat_____.

h. Verify occupancy schedule is programmed into time clock/UMCS_____.

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Contractor's Commissioning Specialist	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's TAB Representative	_____
Contractor's Controls Representative	_____
Design Agency Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____

Functional Performance Test Checklist - Air Cooled Condensing Unit

For Condensing Unit: CU-1

1. Functional Performance Test: Contractor shall demonstrate operation of refrigeration system in accordance with specifications including the following: Start building air handler to provide load for condensing unit. Activate controls system start sequence as follows.

a. Start air handling unit. Verify control system energizes condensing unit start sequence. _____

b. Verify and record data in 2 and 3 below.
c. Shut off air handling equipment to verify condensing unit

de-energizes. _____

d. Restart air handling equipment one minute after condensing unit shut down. Verify condensing unit restart sequence. _____

2. Verify condensing unit amperage each phase and voltage phase to phase and phase to ground.
Motor Full-Load Amps _____

Amperage	Phase 1 _____	Phase 2_____	Phase 3_____
Voltage	Ph1-Ph2 _____	Ph1-Ph3_____	Ph2-Ph3_____
Voltage	Ph1-gnd _____	Ph2-gnd_____	Ph3-gnd_____

3. Record the following information:
Ambient dry bulb temperature _____ degrees F
Suction pressure _____ psig
Discharge pressure _____ psig

4. Unusual vibration, noise, etc.

_____

_____

5. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's TAB Representative _____

Contractor's Controls Representative _____

Design Agency Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Functional Performance Test Checklist - Fan Coil Units

The Contracting Officer will select fan coil units to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent. Hot water and chilled water systems must be in operation providing design water temperatures.

1. Functional Performance Test: Contractor shall demonstrate operation of selected fan coils in accordance with specifications including the following:

a. Cooling only fan coils:

(1) Verify fan coil unit response to room temp set point adjustment.

1. Check blower fan airflow. _____ cfm
2. Check cooling coil water flow. _____ gpm
3. Verify proper operation of cooling water control valve._____
4. Cooling mode inlet air temperature _____deg F
5. Cooling mode outlet air temperature_____deg F
6. Calculate coil sensible capacity and compare to design: Calculated _____BTU/hr Design_____BTU/hr

b. Cooling/heating fan coils:

(1) Verify fan coil unit response to room temp set point adjustment.

1. Check blower fan airflow. _____ cfm
2. Check cooling coil water flow. _____ gpm
3. Verify proper operation of cooling water control valve. ____
4. Check cooling mode inlet air temperature. _____deg F
5. Check cooling mode outlet air temperature. _____deg F
6. Calculate cooling coil sensible capacity and compare to design:
7. Calculated _____BTU/hr Design_____BTU/hr
8. Check heating coil water flow. _____ gpm
9. Verify proper operation of heating water control valve. _____
10. Check heating mode inlet air temperature. _____ deg F
11. Check heating mode outlet air temperature. _____deg F
12. Calculate heating coil capacity and compare to design: Calculated_____BTU/hr design_____BTU/hr

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's TAB Representative _____

Contractor's Controls Representative _____

Design Agency Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

- End of Appendix B -
-End of document
-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 09 53.00 20

SPACE TEMPERATURE CONTROL SYSTEMS
02/10

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 within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating

ASME INTERNATIONAL (ASME)

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 B16.5	(2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B31.1	(2007; Addenda a 2008; Addenda b 2009) Power Piping
ASME B31.5	(2010) Refrigeration Piping and Heat Transfer Components

ASTM INTERNATIONAL (ASTM)

ASTM A 126	(2004; R 2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM B 32	(2008) Standard Specification for Solder Metal
ASTM B 75	(2002) Standard Specification for Seamless Copper Tube
ASTM B 88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM D 1238	(2010) Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1693	(2008) Standard Test Method for

	Environmental Stress-Cracking of Ethylene Plastics
ASTM D 635	(2010) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM D 638	(2010) Standard Test Method for Tensile Properties of Plastics
ASTM D 792	(2008) Density and Specific Gravity (Relative Density) of Plastics by Displacement

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ST 1	(1988; R 1994; R 1997) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013;Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
NFPA 90A	(2009; Errata 09-1) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1966	(2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	Radio Frequency Devices (47 CFR 15)

UNDERWRITERS LABORATORIES (UL)

UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment

1.2 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled "Subcontractor Special Requirements" in Section 01 30 00.00 25 ADMINISTRATIVE REQUIREMENTS. The paragraph specifies that all contract requirements of this section shall be accomplished directly by a first tier subcontractor. No work required shall be accomplished by a second tier subcontractor.

1.3 SYSTEM DESCRIPTION

Provide space temperature control systems complete and ready for operation.

1.4 SYSTEM REQUIREMENTS

Provide control systems composed of any combination of electric, analog electronic or pneumatic devices. Indicated control system devices of a particular type do not intend a requirement for the device unless the requirement is specifically indicated. Requirements apply to field installed control systems.

1.5 CENTRALIZED DIRECT DIGITAL CONTROL (DDC) SYSTEMS

DDC systems are not permitted. Microprocessor-based single-loop controllers, unitary control system, variable-air-volume (VAV) boxes, and room thermostats may be used provided that the devices are manually configurable by the use of device firmware and require no software written by the Contractor for their application and use.

1.6 PERFORMANCE REQUIREMENTS

Provide control systems to maintain the required heating, ventilating, and cooling (HVAC) conditions by performing the functions and sequences of operations indicated. Control systems shall be complete, including all equipment and appurtenances, and ready for operation. Control systems shall be furnished, installed, tested, calibrated, and started up by, or under the supervision of trained technicians certified by the Contractor as qualified and regularly employed in such work. Control system equipment, valves, panels and dampers shall bear the manufacturer's nameplate.

1.7 DESIGN REQUIREMENTS

1.7.1 Control System Diagrams

For each system, indicate HVAC process flow and location of devices relative to flow and to the HVAC control panel, the connections of control devices in control loops, references of control device contacts and device operating coils to line numbers of a ladder diagram and sequencing diagrams showing the operation of valves, dampers, and contacts relative to controller output, and HVAC process variables.

1.7.2 Ladder Diagram

Indicate connections and interlocks to control system devices and other devices such as starters, drives, HVAC control system panels, and HVAC equipment panels. Diagram shall be coordinated by line number and device number with each control system diagram.

1.7.3 Operating Parameters

Indicate operating parameters for devices shown on the control system diagram such as setpoints, ranges, limits, differentials, outside air temperature schedules, contact operating points, and HVAC equipment operating time schedules.

1.7.4 Automatic Control Valve Schedules

Indicate valve size, Cv, flow rate, pressure drop, top size, spring range,

positioner range, operating signal characteristics, and power source.

1.7.5 Damper Schedules

Indicate damper sizes, quantities and sizes of actuators, spring ranges, positioner ranges, operating signal characteristics, and power source.

1.7.6 Wiring Diagram

Indicate terminal blocks, wire marker identification, connections to control system devices, external and internal power sources, and connections to external devices, starters, drives, control panels, jumpers, and ground connections.

1.7.8 Sequence of Operation

Sequence of operation for each HVAC control system coordinated with device identifiers on control system diagram and ladder diagram.

1.7.9 Arrangement Drawing

Arrangement diagram of each HVAC control system panel coordinated with device identifiers on the control system diagram and the ladder diagram.

1.8 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Control system diagrams for each HVAC system; G

Ladder diagram; G

Operating parameters; G

Automatic control valve schedules; G

Damper schedules; G

Sequence of operation; G

Arrangement drawing; G

Wiring diagram; G

SD-03 Product Data

Actuators; G

Valves; G

Dampers; G

Fire protection devices; G

Sensors; G

Thermostats; G

Sunshields; G

Pressure switches; G

Indicating devices; G

Controllers; G

Pressure gages; G

Control panels; G

SD-06 Test Reports

Commissioning procedures; G

Calibration adjustment and commissioning reports; G

Site testing procedures identifying each item tested and describing each test; G

Performance verification test plans and procedures; G

SD-07 Certificates

Certification of completion; G

SD-08 Manufacturer's Instructions

Training course documentation; G

SD-10 Operation and Maintenance Data

Space temperature control system, Data Package 3; G

Submit in accordance with Section 01 78 23.00 25 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Qualified service organization list; G

1.9 QUALITY ASSURANCE

1.9.1 Standard Products

a. Material and equipment shall be standard products of manufacturers regularly engaged in the manufacturing of such products, using similar materials, design and workmanship. The 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 similarly sized equipment and materials used under similar circumstances.

The 2 years experience must be satisfactorily completed by a

product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. 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 tests, can be shown.

b. The equipment items shall be supported by a service organization.

1.9.2 Nameplates and Tags

a. Provide nameplates bearing legends as shown and tags bearing device unique identifiers as shown shall have engraved or stamped characters. Nameplates shall be mechanically attached to HVAC control panel doors.

b. A plastic or metal tag shall be mechanically attached directly to each field-mounted device or attached by a metal chain or wire.

c. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and device identifier where shown.

1.9.3 Verification of Dimensions

Contractor shall become familiar with details of work, shall verify dimensions in the field, and shall advise Contracting Officer of any discrepancy before performing work.

1.9.4 Modification of References

Accomplish work in accordance with ASME B31.1, ASME B31.5, NFPA 70, and NFPA 90A, except as modified herein or indicated otherwise for equipment, materials, installation, examination, inspection, and testing. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had be substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.9.5 Site Testing Procedures

Indicate test equipment to be used including manufacturers' names and model numbers, date of last calibration, and accuracy of calibration.

1.9.6 Commissioning Procedures

Define procedures specific to each control system including instructions on how to set control parameters and setpoints, proportional, integral and derivative mode constants, contact output settings, positioner range adjustments, and calibration checks of transmitters

1.9.7 Calibration Adjustment and Commissioning Reports

Submit specific to each HVAC control system, including settings adjustments and results of calibration checks

1.9.7 Space Temperature Control System

In addition to the requirements specified in the paragraph entitled

"SUBMITTALS", meet the following requirements. Submit Operation and Maintenance Manuals for items of equipment listed under paragraph entitled "Product Data." Manual shall contain full hardware support documentation, which shall include but not be limited to the following:

a. General description and specifications

b. Installation and initial checkout procedures

c. Detailed electrical and logical description

d. Troubleshooting procedures, diagrams, and guidelines

e. Alignment and calibration procedures for components

f. Preventive maintenance requirements and a maintenance checklist

g. Detailed schematics and assembly drawings

h. Spare parts list data, including required tool kits and suggested method of repairs such as field repair, factory repair, or item replacement

i. Signal identification and timing diagrams

j. Complete as-built control drawings, schedules, and sequence of operation

k. Controller configuration and parameter setting procedures

l. Step-by-step procedures required for each HVAC control systems startup, operation, shutdown, recovery, and fault diagnosis

m. Manufacturer supplied operator manuals for equipment

n. Qualified service organization list

PART 2 PRODUCTS

2.1 COMPONENTS

Provide components factory ordered for this project. Rebuilt equipment, warehoused equipment, or earlier generation equipment shall not be acceptable. Electrical, electronic, and electropneumatic devices not located within control panels shall have a NEMA 250 Type 1 enclosure in accordance with NEMA 250 unless otherwise specified. Actuators and positive positioners, and transmitters shall operate within temperature limit ratings of plus 35 to 150 degrees F. Panel mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 35 to 150 degrees F.

2.2 ACTUATORS

Provide pneumatic, electric, or electronic actuators. Actuators shall function as required within 85 to 110 percent of their power supply rating. Actuators shall fail to their spring return positions on signal or power failure unless indicated as timed, power return actuators. Actuators shall have visible position indicators. Where actuators do not have positive

spring returns for fail-safe operation, provide capacity tanks, restrictors, check valves, and relays, or reserve power as required to achieve proper timed positioning for up to 4 minutes after primary power failure. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale signal input change. Pneumatic actuators shall be rated for 25 psig operating pressure except for high pressure cylinder type actuators.

2.2.1 Damper Actuators

Damper actuators shall be rated for at least 125 percent of the motive power necessary to operate the connected damper. The actuator stroke shall be limited by an adjustable stop in the direction of the return stroke. Actuators shall be provided with mounting and connecting hardware.

2.2.2 Valve Actuators

Valve actuators shall be rated for at least 125 percent of the motive power necessary to operate the valves over their full range of operation against the total and differential pressures.

2.2.3 Positive Positioners

Positive positioners shall be pneumatic relays with mechanical feedback mechanisms, adjustable operating ranges, and starting points.

2.3 AUTOMATIC CONTROL VALVES

Provide automatic control valves.

2.3.1 Valve Assembly

Valves shall have stainless steel stems and stuffing boxes with extended necks to clear the piping insulation. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Maximum rated shutoff pressure of the valve shall exceed the rated deadhead pressure of the pump that supplies it. Valve leakage rating shall be 0.01 percent of rated Cv for soft-seated valves and 0.05 percent for metal-to-metal seated valves. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall conform to ASME B16.5 as a minimum. Components of cast iron valves shall conform to ASTM A 126 Class B or C as a minimum.

2.3.2 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service, and for modulation to the fully closed position, with carbon steel bodies or cast iron Class 125 and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 20 degrees to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator.

2.3.3 Two-Way Valves

Two-way modulating valves shall have equal percentage characteristics.

2.3.4 Three-Way Valves

Three-way valves shall provide constant total flow throughout full plug

travel.

2.3.5 Duct-Coil and Terminal-Unit-Coil Valves

Control valves with either flare-type or solder-type ends shall be provided for duct or terminal-unit coils. Flare nuts shall be provided for each flare-type end valve.

2.4 DAMPERS

Provide dampers in air ducts.

2.4.1 Damper Assembly

Damper shall conform to SMACNA 1966. 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 sizes shall consist of a combination of sections. Dampers shall be steel or other materials where indicated. Flat blades shall be made rigid by folding the edges. Provide blades with compressible seals at points of contact. Provide channel frames of dampers with jamb seals to minimize air leakage. Dampers shall not leak in excess of 10 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. Moving parts of the operating linkage in contact with each other shall consist of dissimilar materials. 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 a non-ferrous dissimilar thrust bearings. Pressure drop through dampers shall not exceed 0.05 inch water gage at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches wide. Dampers shall be tested in accordance with AMCA 500-D.

2.4.2 Operating Links

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 at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Mating parts shall consist of dissimilar 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.

2.5 FIRE PROTECTION DEVICES

Provide smoke detectors in return and supply air ducts on the downstream side of the filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL listed or FM approved detectors for duct installation.

2.5.1 Smoke Detectors

Provide in each air-handling system with supply air capacity greater than 2000 cfm in accordance with NFPA 90A. Locate downstream of the supply air filters and prior to any branch connection in accordance with NFPA 72. Provide in each air-handling system, serving more than one story, and having a return air capacity greater than 15000 cfm in accordance with NFPA

90A. Locate at each story prior to connection to common return and at return connection to air handler prior to any fresh air inlet connection and prior to any recirculation connection in accordance with NFPA 72. Smoke control and exhaust systems shall have provision for automatic and manual operation by means of a key-operated switch to override any other shutdown features and shall be located as indicated.

Provide in each air-handling system with supply air capacity greater than 944 L/s 2000 cfm in accordance with NFPA 90A. Locate downstream of the supply air filters and prior to any branch connection in accordance with NFPA 72.

Provide in each air-handling system, serving more than one story, and having a return air capacity greater than 7079 L/s 15000 cfm in accordance with NFPA 90A. Locate at each story prior to connection to common return and at return connection to air handler prior to any fresh air inlet connection and prior to any recirculation connection in accordance with NFPA 72. 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 undesired 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. A ground fault or single break or open condition in electrical circuitry to any detector or its control or power units shall cause activation of building fire alarm control panel trouble signals.

Electrical supervision of wiring used exclusively for air-handling unit shutdown is not required provided a break in wiring would 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, the existing building fire alarm system.

Provide in each air-handling system with supply air capacity greater than 944 L/s 2000 cfm in accordance with NFPA 90A. Locate downstream of the supply air filters and prior to any branch connection in accordance with NFPA 72. Provide in each air-handling system, serving more than one story, and having a return air capacity greater than 7079 L/s 15000 cfm in accordance with NFPA 90A. Locate at each story prior to connection to common return and at return connection to air handler prior to any fresh air inlet connection and prior to any recirculation connection in accordance with NFPA 72.

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 undesired operation by changes in 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 115 Vac power supply unit integral with duct housing. Obtain power from the location indicated. Detectors shall have test port or test switch. Provide each detector with a visible indicator lamp that lights when the detector is activated.

Activation of duct detector shall cause shutdown of the associated air-handling unit and closing of dampers and shall sound an alarm bell, with minimum 6 inch diameter, in a normally occupied area located as indicated.

2.6 SENSORS

2.6.1 Spans and Ranges

Transmitters shall be calibrated to provide an electric or electronic output signal of 4 to 20 mA electric or electronic and 3 to 15 psi output for pneumatics over the indicated span or range.

a. Conditioned space temperature, from 50 to 100 degrees F.

b. Duct temperature, from 40 to 140 degrees F.

h. Outside air temperature, from minus 30 to 130 degrees F.

2.6.2 Temperature Sensors

2.6.2.1 Resistance Temperature Detectors (RTD's)

RTD shall be platinum with a tolerance of plus or minus 0.25 percent at 32 degrees F, and shall be encapsulated in epoxy, Series 300 stainless steel, anodized aluminum, or copper. RTD shall be furnished with RTD transmitter as specified, integrally-mounted unless otherwise indicated.

2.6.2.2 Continuous Averaging RTD's

Continuous averaging RTD's shall have a tolerance of plus or minus 1.0 degrees F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. Sensing element shall have a bendable copper sheath. Averaging RTD shall be furnished with RTD transmitter as specified, to match the resistance range of the averaging RTD. Element length shall be a minimum of one linear foot per square foot of coil face area.

2.6.2.3 RTD Transmitter

RTD transmitter shall be selected to match the resistance range of the RTD. Transmitter shall be a two-wire, loop-powered device. Transmitter shall produce a linear 4 to 20 mA dc output corresponding to required temperature measurement. Output error shall not exceed 0.1 percent of the calibrated measurement. Transmitter shall include offset and span adjustments.

2.6.6 Pressure Sensors

Provide electronic pressure sensor and transmitter. Sensor shall be a pressure transmitter with an integral sensing element. Sensor over pressure rating shall be 25 psig above its normal operating range. Sensing

element accuracy shall be plus or minus one percent of full scale. Transmitter accuracy shall be plus or minus 0.1 percent of the calibrated measurement. Transmitter shall be a two-wire, loop-powered device. Transmitter shall produce a linear 4 to 20 mA dc output corresponding to required pressure measurement. Transmitter shall have offset and span adjustments.

2.7 THERMOWELLS

Provide brass or Series 300 stainless steel thermowells with threaded brass plug and chain, 2 inch lagging neck and extension type well, and inside diameter and insertion length as required for the application. Provide thermowells for immersion sensors with conducting material inside the well.

2.8 THERMOSTATS

Provide thermostats.

2.8.1 Ranges

Thermostat ranges shall be selected so that the setpoint is adjustable between plus or minus 10 degrees F of the setpoint indicated.

2.8.2 Nonmodulating Electric Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 2 degrees F. Thermostat covers shall consist of locking metal or heavy-duty plastic, and shall be capable of being locked by an Allen wrench or special tool. Thermostats shall have manual switches as required by the application and a minimum range of 55 to 90 degrees F.

2.8.3 Microprocessor-Based Room Thermostats

Microprocessor-based room thermostats shall have built-in keypads for scheduling of day and night temperature settings. Access to the scheduling mode shall be by password control code. When out of the scheduling mode, thermostats shall have continuous 12-hour time display, with AM and PM indication, continuous display of day of the week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, use the display for setting and interrogating time program ON-OFF setpoints for each day of the week. The time program shall allow two separate temperature setback intervals per day. Thermostats shall have a means for temporary and manual override of program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain timing and to maintain the schedule in memory for one year in the event of a power outage. Maximum differential shall be 2 degrees F. Where used for heat pump applications, thermostat shall have an emergency heat switch.

2.8.4 Nonmodulating Capillary Thermostats and Aquastats

a. Thermostat shall have a capillary length of at least 5 feet, adjustable direct reading scales for both setpoint and differential, and a differential adjustable from 6 to 16 degrees F.

b. Aquastats shall be strap-on type, with 10 degrees F fixed differential.

2.8.6 Modulating Capillary Thermostats

Thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. \7Thermostats shall have adjustable throttling ranges of 4 to 8 degrees F for each output.

2.9 SUNSHIELDS

Provide sunshields for outside air temperature sensing elements to prevent the sun from directly striking temperature sensing elements. Provide sunshields with adequate ventilation so that the sensing element responds to the ambient temperature of surroundings. The top of each sunshield shall have galvanized metal or aluminum rainshield projecting over the face of the sunshield. Sunshields shall be painted white or shall be unpainted aluminum.

2.10 PRESSURE SWITCHES AND SOLENOID VALVES

Provide pressure switches and solenoid valves.

2.10.1 Pressure Switches

Switches shall have an adjustable setpoint with visible setpoint scale. Range shall be as indicated. Differential adjustment shall span 20 to 40 percent of the range of the device.

2.10.2 Differential Pressure Switches

Switches shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. Fittings shall be angled-tip type with tips pointing into the airstream. Range shall be 0.5 to 6 inches water gage. Differential shall be a maximum of 0.15 inch water gage at the low end of the range and 0.35 inch water gage at the high end of the range.

2.11 INDICATING DEVICES

Provide indicating devices.

2.11.1 Thermometers

a. Thermometers for insertion in ductwork and piping systems shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, and permanently stabilized glass tube with an indicating fluid column, white face, black numbers, and a 9 inch scale.

b. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

c. Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid stem thermometers, the space between bulb and stem shall be filled with a heat transfer medium.

d. Air duct thermometers shall have perforated stem guards and 45 degree adjustable duct flanges with locking mechanisms.

e. Averaging thermometers shall have 3.5 inch (nominal) dial, with black legend on white background, and pointer traveling through a 270 degree arc.

f. Thermometers shall have an accuracy of plus or minus one percent of scale range. Thermometers shall have the following ranges:

(1) Mixed air temperature: 0 to 100 degrees F in 1 degree F graduations.

(2) Return air temperature: 0 to 100 degrees F in 1 degree F graduations.

(3) Cooling coil discharge temperature: 0 to 100 degrees F in 1 degree F graduations.

(4) Heating coil discharge temperature: 30 to 180 degrees F in 2 degree F graduations.

2.12 LOW-DIFFERENTIAL PRESSURE GAGES

Gages for low-differential pressure measurements shall be 4 1/2 inch (nominal) size with two seats of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gages shall have ranges and graduations as indicated. Accuracy shall be plus or minus 2 percent of scale range.

2.13 CONTROLLERS

2.13.1 Single-Loop Controllers

2.13.1.1 Controller Features

Controller shall be a microprocessor-based, single-loop device that does not require Contractor-generated software. Controller shall conform to FCC Part 15. Controller panel cutout shall be 3.62 by 3.62 inches. Controller shall have field selectable range for process variables, a remote setpoint analog input and analog output with adjustable high and low end limits, and proportional control manual reset adjustment. Analog output shall result from PID control. Analog output shall be configurable as direct acting and reverse acting. Controller shall have keyboard, display, auto/manual selection for control of analog output, and remote setpoint adjustment/local setpoint adjustment selection. Controller shall have adjustable high-end and low-end limits, ratio, and bias adjustments on remote setpoint input; operator initiated self-tune/manual-tune selection, anti-reset wind-up feature, and two configurable independent SPDT with adjustable system contact closure outputs. Controller shall be configurable to power-up in manual with local setpoint control, in automatic with local setpoint control, and in automatic with remote setpoint control. Contact closures shall be activated by a process variable and by a process variable deviation from setpoint as configured. The range of hysteresis adjustment shall not be smaller than 1 percent to 5 percent of process variable input span. Controller shall power the analog output loop to 20 mA where connected to a load of 600 ohms. Controller shall have 5-year battery backup or shall have nonvolatile memory to store operating parameters.

2.13.1.2 Controller Parameter Input and Display

Control parameters shall be entered and displayed directly, in the correct engineering units, through a series of keystrokes on a front panel display with a 3 1/2-digit, seven-segment display, with decimal point and polarity indication. Use of the display shall allow manual interrogation of setpoint, mode constants, and values of process variables and outputs.

2.13.1.3 Controller Electrical Requirements

Controller shall be powered by 120 Vac. Controller shall provide electrical noise isolation, not less than 100 dB at 60 Hz common mode rejection ratio, and not less than 60 dB at 60 Hz normal mode rejection ratio between ac power line and process variable input, remote setpoint input, and output signals.

2.13.1.4 Controller Accuracy

Controller shall have an accuracy of plus or minus 0.30 percent of input span, plus or minus one digit.

2.13.1.5 Controller Self Tuning

Controller self-tuning operation shall apply proportional, integral, and derivative modes of control; mode constants shall be modified as required. Self tuning shall only operate when selected from the front panel.

2.13.1.6 Controller Manual Tuning

Controller manual tuning operation shall provide proportional, integral, and derivative control modes, or any combination thereof, by means of individual mode constant adjustments. Adjustments shall be set for the appropriate value if a particular control mode action is desired, or to zero for the particular mode not desired. The proportional mode constant shall be adjustable from 0 to 200 percent of input signal range; the integral mode constant shall be adjustable from 0 to 20 repetitions per minute; and the derivative mode constant shall be adjustable from 0 to 5 minutes.

2.13.3 Analog Electronic Controllers

Controllers shall be solid-state electronic devices which sense the difference between input sensor analog values (resistance or voltage) and setpoint adjustment analog values (resistance or voltage), and shall amplify the difference signal to provide the output signal. Controllers shall include the following:

a. Proportional band: 2.5 to 33 percent of input device span.

b. Authority: minimum of 33 to 200 percent.

c. Inputs: thermistor, resistance, transmitter, or output of other electronic controllers.

d. Outputs: within the range of minus 5 to 20 Vdc or a 4 to 20 mA dc current loop.

e. Remote setpoint adjustment (SPA): plus or minus 10 percent of

input device span.

2.13.4 Unitary Control Systems

Unitary control systems shall be energy-efficient, micro-processor-based temperature controllers and associated devices that do not require Contractor-generated software. Provide control systems with integral or remote sensor as indicated. Controllers shall operate heating, cooling, and ventilating modes with independent occupied and unoccupied settings for each of 7 consecutive days. Cooling shall be controlled in two steps and heating shall be controlled in two steps with modulating control provided for the ventilation mode. Provide temperature changeover control to limit the ventilation mode when outdoor air temperature is not sufficiently low for "free-cooling." Provision shall be made for automatic changeover between heating and cooling modes, providing a one minute minimum time delay between the start and stop operation of heating and cooling stages upon startup and after power failure to prevent short cycling and power surges. Provide an optimum startup program to minimize warm-up or cool-down periods prior to the occupied mode. Outside air dampers shall be closed during the optimum startup program unless outside air is beneficial for cool-down in lieu of mechanical cooling. Fan shall operate continuously during the occupied mode and shall cycle during the unoccupied mode for heating or cooling. Provide battery backup to retain programs and maintain clock operation for 48 hours minimum during power outages. Controller shall have a self-diagnostic program to indicate errors and locking covers to prevent unauthorized program entries. Provide a convenient means to restore the occupied mode of operation for a minimum 2-hour period without removing covers. An indexing switch shall allow operation in a continuous unoccupied mode during abnormal periods without changing normal programs.

2.13.5 Pneumatic Low-Range Pressure Controllers for Ductwork Applications

Controllers shall provide two-pipe, pilot-operated control with pneumatic feedback and proportional action. Sensing elements shall be differential type with pressure ranges appropriate for intended service. One element shall measure the variable while the other element measures the standard reference. Static pressure controllers shall have slack diaphragms with standard ranges between 0 to 6 inches water gage and an adjustable throttling range of 0.02 to 0.5 inch water gage. Sensing element shall be mountable in ductwork and shall measure static pressure without pulsations.

2.13.6 Pneumatic Differential Pressure Controllers for Liquid Applications

Differential pressure controllers shall have a minimum range of 0 to 50 psig or 0 to 250 psig as specified or required for the application and shall have an adjustable throttling range of 1 to 25 psig. Sensing element shall be filled diaphragm type with three-valve manifold for isolation and nulling. Provide syphons and pressure snubbers.

2.14 CONTROL DEVICES AND ACCESSORIES

Provide control devices and accessories.

2.14.1 Function Modules

Function modules shall accept mA dc analog input signals to produce analog output signals or contact output signals. Modules shall have zero and span adjustments for analog outputs, and setpoint adjustments for contact

outputs.

2.14.1.1 Minimum Position Switches and Temperature Setpoint Devices

Minimum position switches and temperature setpoint devices shall accept manual input and shall produce steady analog output. Switches and devices shall be suitable for recessed wall mounting or panel mounting and shall have a graduated dial.

2.14.1.2 Signal Inverter Modules

Signal inverter modules shall accept analog input signal and produce analog output signal that linearly reverses the direction of signal change of input versus output.

2.14.1.3 High-Low Signal Selector Modules

High-low signal selector modules shall accept analog input signals and select either the highest or the lowest input signal as the output signal.

2.14.1.4 Sequencer Modules

Sequencer modules shall provide fixed time delayed sequencing of one or more contact transfers from an analog input signal. Sequencers shall return contacts to their zero input signal condition when power is interrupted.

2.14.2 Relays

Relays shall be two-pole, double-throw (DPDT) with a 10-ampere resistive rating at 24 Vac, and shall have an enclosed coil. Provide with a light indicator which is lit when the coil is energized and is not lit when the coil is not energized.

2.14.3 Time-Delay Relays

Time-delay relays shall be DPDT with octal connectors and dust covers. The adjustable timing range shall be 0 to 3 minutes.

2.14.4 Time Clocks

Time clocks shall be a 24-hour, 365-day programmable timing device with two independently timed circuits. Clocks shall have a manual scheduling keypad and alphanumeric display of timing parameters. Timing parameters shall include Gregorian calendar date for month, day and day-of-month indication; and 24-hour time-of-day display, with one-minute resolution for programming the ON and OFF times for each circuit. Circuits shall have programmable timed override from 1 to 99 minutes. Clocks shall have capacity for programming four ON events and four OFF events for each circuit. Programmed events shall be assignable to a 365-day schedule. Clocks shall have automatic standard time and daylight saving time adjustments, keyed to input of appropriate dates. Provide clocks with 4-day battery backup.

2.14.5 Override Timer

Override timers shall be manually set, mechanically driven timers, or electronic timers, without a "hold" feature. Time intervals shall be selectable for up to 12 hours of operation and shall expire unless reset.

2.14.7 Regulated Power Supplies

Power supplies shall provide a 24-Vdc linear supply at not less than 2 amperes, with regulation to 0.05 percent of output voltage. Power supplies shall have a fused input, and shall be protected from voltage surges and power-line transients. Power supply output shall be protected against overvoltage and short circuits. Power supply loading shall not be greater than 1.2 amperes.

2.14.8 Transformers

UL 508 and NEMA ST 1 as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for available voltage and secondaries wound for correct control circuit voltage. Transformers shall be sized so that connected loads equal 80 percent of rated capacity. Transformers shall be enclosed in rustproof, galvanized steel cabinets with conduit connections. Disconnect switch shall be provided on the primary side, and a fuse cutout on the secondary side.

2.14.9 Pilot Lights and Manual Switches

Device illumination shall be by light-emitting diode (LED) or neon lamp. Switches shall have operating levers and index plates showing switch positions and names of apparatus controlled or other appropriate designations.

2.15 HVAC SYSTEM CONTROL PANELS

Provide HVAC system control panels.

2.15.1 Panel Assembly

Panel shall be fabricated for bottom entry connection for control system electric power, control system main air source, control system wiring, pneumatic tubing, interconnection of control systems, interconnection of starters, and external shutdown devices. Panel shall have an operating temperature rise of not greater than 20 degrees F above an ambient temperature of 100 degrees F.

2.15.2 Panel Electrical Requirements

Control panel shall be powered by nominal 120 Vac terminating at panel on terminal blocks. Instrument cases shall be grounded. Interior and exterior panel enclosures shall be grounded.

2.15.3 Enclosures

Enclosures for each panel shall be a single door, wall-mounted box conforming to NEMA 250 with a continuous hinged and gasketed exterior door with a print pocket, key lock, and interior back panel. Inside finish shall be white enamel, and outside finish shall be gray primer over phosphatized surfaces.

2.15.4 Mounting and Labeling

Provide pilot lights, switches, panel-mounted control devices, and pressure gages shall be mounted on the door. Power conditioners, fuses, and duplex outlets shall be mounted on the interior of the cabinet. Other components housed in the panel shall be mounted on the interior back panel surface of

the enclosure and shall be identified by plastic or metal nameplates which are mechanically attached to the panel. Lettering shall be cut or stamped into the nameplate to a depth of not less than 1/64 inch, and shall have contrasting color, produced by filling with enamel or lacquer or by use of laminated material. Painting of lettering directly on the surface of the door or interior back panel is not permitted.

2.15.5 Wiring and Tubing

a. Pneumatic device inputs and outputs shall be piped to bulkhead fittings in the bottom of the panel with a 2 inch loop to facilitate replacement. Electric, electronic, and electropneumatic device signals entering and leaving the panel shall be wired to identified terminal blocks.

b. Wiring shall be installed in wiring ducts so that devices can be added or replaced without disturbing existing wiring that is not affected by the change. Wiring to single-loop controllers shall have a 4 inch wiring loop in the horizontal wiring duct at each wiring connection. There shall be no wiring splices within the control panel. Interconnections required for power or signals shall be made on device terminals, if available, or panel terminal blocks, with not more than two wires connected to each terminal.

c. Instrument signal grounds at the same reference level shall end at a grounding terminal connected to a common ground point for that level. Wiring shield grounds at the same reference level shall end at a grounding terminal connected to a common ground point for that level. Grounding terminal blocks shall be identified by reference level.

d. Wiring connected to controllers shall be identified by function and polarity, e.g., process variable input and remote setpoint input and output.

2.18 CONTROL TUBING AND WIRING

Provide HVAC control tubing and wiring.

2.18.1 Tube and Fittings

2.18.1.1 Copper Tubing

ASTM B 75 or ASTM B 88. Tubing 0.375 inch outside diameter and larger shall have a minimum wall thickness equal to ASTM B 88, Type M. Tubing less than 0.375 inch outside diameter shall have a 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 ASME B16.18 or ASME B16.22, using ASTM B 32, Plumbing Code approved lead-free solder, or compression type ASME B16.26.

2.18.1.2 Polyethylene Tubing

Polyethylene tubing shall be provided only for systems with working pressure of 30 psig or less. Provide flame-resistant, multiple polyethylene

tubing in flame-resistant protective sheath with Mylar barrier, or unsheathed flame-resistant 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, except prohibited in crawl spaces, attics, and above-ceiling spaces that are vented to the outdoors. Do not provide polyethylene tubing for smoke removal systems. Number each tube in sheathing each two feet minimum. Permanently identify unsheathed tubing at each end. Provide compression or barbed push-on type fittings. 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.

e. Density (average): ASTM D 792, 57.5 pounds per cubic feet.

f. Burn rate: ASTM D 635.

2.18.2 Wiring

a. Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanisms. Terminal blocks shall be rail mounted, and shall have end plates, partition plates or enclosed sides for separation.

b. Control wiring for 24-V circuits shall be 18 AWG minimum and shall be rated for 300-V service.

c. Wiring for circuits operating at more than 100 V shall be 14 AWG minimum and shall be rated for 600-V service.

d. Analog signal wiring circuits within control panels shall not be less than 20 AWG and shall be rated for 300-V service.

e. Instrumentation cable shall be 18 AWG, stranded copper, single or multiple twisted, minimum 2-inch lay of twist, 100 percent shielded pairs, and shall have 300-V insulation. Each pair shall have a 20-AWG tinned copper drain wire, individual pair, and overall insulation. Cables shall have an overall aluminum polyester or tinned overall copper cable shield tape, 20-AWG tinned-copper cable drain wire, and overall cable insulation.

f. Nonconducting wiring ducts in control panels shall have slotted side snap-on covers, fittings for connecting ducts, mounting clips for securing ducts, and wire retaining clips.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under the supervision of competent technicians

regularly employed in the installation of control systems. Provide components for a complete and operational control system. Provide control system complete and ready for operation, as specified and indicated. Provide dielectric isolation where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be watertight. Control system installation shall provide adequate clearance for control system maintenance by maintaining access spaces between coils, to mixed-air plenums, and as required to calibrate, remove, repair, or replace control system devices. Control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance. Install devices mounted in or on piping or ductwork, on building surfaces, in mechanical and electrical spaces, or in occupied space ceilings in accordance with manufacturer's recommendations and as indicated on contract documents. Provide control devices to be installed in piping and ductwork with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Certify that installation of control system is complete and technical requirements of this section have been met.

3.1.1 Sensors

Provide sensors in locations to sense the appropriate condition. Install sensor and transmitter where easily accessible and serviceable without special tools. Sensors shall be calibrated to the accuracy specified in the contract, and operate correctly when installed. Do not install sensors designed for one application in the place of another application (e.g., replacing a duct sensor with a room sensor).

3.1.1.1 Room Sensors

Provide on interior walls to sense average room conditions. Avoid locations which may be covered by office furniture. Do not mount room sensors on exterior walls if other locations are available. Mount centerline of sensor 5 feet above finished floor.

3.1.1.2 Duct Temperature Sensors

Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Locate sensor connection boxes in position not obstructed by ducts or equipment. Install gaskets between sensor housing and duct wall. Seal duct and insulation penetrations. Install duct averaging sensors between two rigid supports in serpentine position to sense average conditions. Sensor shall have a total minimum length of one linear foot per 4 square feet of duct area. Sensor shall be mounted a minimum of 3 inches from outside wall surface. Thermally isolate temperature sensing elements from supports. Provide duct access doors to averaging sensors.

3.1.1.3 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 effect proper flow across entire area of the well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Temperature sensors shall be installed in thermowells with thermal transmission material to

speed the response of temperature measurement. Provide thermowells with sealing nuts to contain thermal transmission material.

3.1.1.4 Strap-on Temperature Sensors

Strap-on temperature sensors, using helical screw stainless steel clamps, shall be permitted on new hot water piping for on-off operation, and for existing hot water piping sizes not greater than 3 inches. Clean the pipe to bright metal. Insulate strap-on bulb and pipe after installation. Provide other liquid temperature sensors with thermowells. Provide NEMA 250 Type 4 enclosures for outdoor installations. Provide brushed aluminum or brushed stainless steel enclosures for sensors located in finished spaces.

3.1.1.5 Outside Air Temperature Sensors

Provide outside air temperature sensor on north side of building, away from exhaust hoods, air intakes, and other areas which may affect temperature readings. Install sunshields to protect outside air temperature sensor from direct sunlight.

3.1.2 Thermometers

Provide thermometers which are installed in liquid systems in thermowells with thermal transmitting materials within the well to speed the response of temperature measurement.

3.1.3 Pressure Sensors

3.1.3.1 Duct Static Pressure

Duct static pressure sensor shall be located where indicated on drawings. If no location is indicated, it should be located approximately two-thirds of distance from supply fan to the end of duct with greatest pressure drop.

3.1.4 Pressure Gages

Provide snubbers for gages in piping systems subject to pulsation. Gages for steam service shall have pigtail fittings with cocks. Install pressure gages at locations indicated. Pneumatic output lines shall have pressure gages mounted near the control panel.

3.1.5 Valves

Provide valve with stems upright where possible but with stems not lower than horizontal. Provide positioners where indicated and where necessary to prevent overlap of heating and cooling where one controller operates more than one pneumatic device and to maintain the proper dead band between heating and cooling.

3.1.6 Damper Actuators

Provide damper actuators so that the damper sealing action is smooth and sufficient to maintain leakage at or below specified leakage rate. Multiple actuators operating a common damper shall be connected to a common drive shaft. Provide positioners where indicated and where necessary to prevent overlap of heating and cooling where one controller operates more than one pneumatic device and to maintain the proper dead band between heating and cooling.

3.1.7 Access Doors

Provide access doors in ductwork to service airflow monitoring devices, devices with averaging elements, and low-temperature protection thermostats (freezestats).

3.1.9 Wiring

a. Provide wiring external to control panels, including low-voltage wiring, in metallic raceways. Install wiring without splices between sensors, transmitters, control devices, and HVAC control panels. Install instrumentation grounding as necessary to prevent ground loops, noise, and surges adversely affecting operation of the system. Tag cables, conductors, and wires at both ends, with identifiers indicated on shop drawings.

b. Other electrical work shall be specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide step-down transformers where control equipment operates at lower than line circuit voltages. Transformers serving individual heating, ventilating, and air-conditioning units shall be fed from fan motor leads, or fed from the nearest distribution panelboard or motor control center, using circuits provided for that purpose.

c. Ground control panels and cabinets as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Grounding of the green ac ground wire at the breaker panel alone is not adequate. Install ground wire from each control panel to adequate building ground.

3.1.12 Control Drawings

Post laminated copies of as-built control system drawings in each mechanical room.

3.2 ADJUSTMENTS

Calibrate instrumentation and controls, and verify specified accuracy using test equipment traceable to National Institute for Science and Technology (NIST) standards. Adjust controls and equipment to maintain conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.3 FIELD QUALITY CONTROL

a. Demonstrate compliance of HVAC control systems. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Calibrate test equipment in accordance with NIST standards. Ensure that tests are performed or supervised by competent employees of the control system installer or the control system manufacturer regularly employed in testing and calibration of control systems.

b. Testing shall include field tests and the performance verification test. Field tests shall demonstrate proper calibration of instrumentation, input and output devices, and operation of specific equipment. The performance verification test shall ensure proper execution of sequence of operation and proper tuning of control loops.

c. The plan for each phase of field acceptance testing shall be approved in writing before beginning that phase of testing. Furnish written notification of planned testing to Contracting Officer at least 21 days prior to testing. Include proposed test procedures with notification. The Contractor will not be allowed to start testing without written Government approval of test procedures. Test procedures shall consist of detailed instructions for complete testing to prove the performance of heating, ventilating, and air-conditioning system and control system. Include the following tests in test procedures.

d. Submit original copies of data produced, including results of each test procedure, to the Government at the conclusion of each phase of testing. Tests are subject to supervision and approval by Contracting Officer. Do not perform testing during scheduled seasonal off-periods of heating and cooling systems.

3.3.1 Test Reporting

After completion or termination of field tests and again after the performance verification test, identify, determine causes, replace, repair, or calibrate equipment which fails to meet the specification; and deliver a written report to the Government. The report shall document test results, explain in detail the nature of each failure, and corrective action taken. After delivering the performance verification test report, the Contractor shall convene a test review meeting at the job site to present results and recommendations to the Government. As a part of the test review meeting, the Contractor shall demonstrate by performing appropriate portions of field tests or the performance verification test that failures have been corrected. Based on Contractor's report and test review meeting, the Government will determine either the restart point or successful completion of testing. Do not commence required retesting until after receipt of written notification by the Government. At the conclusion of retesting, repeat the assessment.

3.3.2 Contractor's Field Testing

Calibrate field equipment and verify equipment and system operation before system is placed on-line. Include the following tests in field testing.

3.3.2.1 Tubing and Wiring Integrity Tests

Test tubing system pneumatically at 1.5 times the design working pressure for 24 hours. Allowable leakage rate is that which produces a pressure drop 1 psig in 24 hours with compressed air supply turned off. Test wiring for continuity, ground faults, and open and short circuits.

3.3.2.2 System Inspection

Observe HVAC control system in shutdown condition. Check dampers and valves for proper normal positions. Document positions for the performance verification test report.

3.3.2.3 Calibration Accuracy and Operation of Input Test

Verify correct calibration and operation of input instrument. For each sensor and transmitter, including for temperature, pressure, relative humidity, and dew point inputs, record the reading at the sensor or transmitter location using calibrated test equipment. Record the output

reading provided by that sensor or transmitter. Document each of these location and output readings for the performance verification test report. The test equipment shall have been calibrated within one year of the date of use in the field. Test equipment calibration shall be traceable to the measurement standard of the National Institute of Standards and Technology.

3.3.2.4 Operation of Output Test

Check the operation of output to verify correct operation. Operate analog device to minimum range (e.g., 4 mA) and maximum range (e.g., 20 mA), and measure and record actual output values.

3.3.2.5 Actuator Range Adjustment

With the controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position through to the full range of stroke position. Record actual spring ranges and normal positions for modulating control valves and dampers.

3.3.3 Coordination With HVAC System Balancing

Tune the control system after air and hydronic systems have been balanced, minimum damper positions have been set, and a report has been issued.

3.3.4 Field Test Documentation

Before scheduling the performance verification test, provide field test documentation and written certification of completion to Contracting Officer and the Naval Energy and Environmental Support Activity (NEESA), that the installed system has been calibrated, tested, and is ready to begin the performance verification test. Do not start the performance verification test prior to receiving written permission from the Government.

3.3.5 Performance Verification Test

Conduct the performance verification tests to demonstrate that the control system maintains setpoints and that the control loops are tuned for the correct sequence of operation. Conduct the performance verification test during one week of continuous HVAC and control systems operation and before final acceptance of work. Specifically, the performance verification test shall demonstrate that the HVAC system operates properly through the complete sequence of operation (e.g., seasonal, occupied and unoccupied, warm up, etc.), for specified control sequences. Demonstrate proper control system response for abnormal conditions for which there is a specified system or controls response by simulating these conditions. Demonstrate that hardware interlocks and safety devices work as designed. Demonstrate that the control system performs the correct sequence of control.

3.4 TRAINING

Provide a qualified instructor to conduct training courses for designated personnel in maintenance and operation of HVAC and control systems. Orientate training to the specific system being installed under the contract. Furnish audiovisual equipment and 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, assume that the attendees have a high school education and are familiar with HVAC systems. Submit planned training schedule, agenda, and class materials to the Government at least 45 days prior to training.

3.4.1 Training Course Documentation

Training shall be based on the operation and maintenance manuals and control system training manual. Deliver manuals for each trainee with two additional sets for archiving at the project site. Include an agenda, defined objectives, and a detailed description of subject matter for each lesson.

3.4.2 Operator Training I

The first class shall be taught for a period of 5 consecutive training days at least 1 month prior to the scheduled performance verification test. The first course shall be taught in a Government-provided facility on base. Training shall be classroom instruction, but have hands-on operation of similar digital controllers. Maximum of 5 personnel shall attend the course. Upon completion of course, each student, using appropriate documentation, shall be able to perform elementary operations, with guidance, and describe general hardware and functionality of the system. Course shall include but not be limited to description of hardware and operation of the system.

3.4.3 Operator Training II

The second course shall be taught in the field, using the operating equipment at project sites for a total of 16 hours of instruction per student, in blocks of 4 hours. Maximum of 5 personnel shall attend the course. Include hands-on training under constant monitoring of instructor. Course content shall duplicate the Operator Training I course as applied to the installed system. Instructor shall determine the level of the password to be issued to each student before each session. Upon completion of the course, students shall be proficient in system operation. Prepare a written report describing the skill level of each student at the end of the course.

3.4.5 System Maintenance Training

Course shall be taught at the project site within one month after completion of endurance test for a period of 2 training days. Maximum of 4 personnel shall attend the course. Course shall include but not be limited to the following:

a. Physical layout for each piece of hardware

b. Troubleshooting and diagnostics procedures

c. Repair instructions

d. Preventive maintenance procedures and schedule

e. Calibration procedures

3.5 QUALIFIED SERVICE ORGANIZATION LIST

The qualified service organization list shall include names and telephone

numbers of organizations qualified to service HVAC control systems.

3.6 COMMISSIONING

Commissioning of control systems is specified in the pre-field TAB engineering report described in Section 23 05 93 TESTING, ADJUSTING AND BALANCING.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 23 00

REFRIGERANT PIPING
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.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 720	(2002) Refrigerant Access Valves and Hose Connectors
ANSI/AHRI 750	(2007) Thermostatic Refrigerant Expansion Valves

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34	(2010; Std 15 Addenda a, b, d; Std 34 Addenda a, b, d) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 17	(2008) Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2004) Specification for Filler Metals for Brazing and Braze Welding
AWS BRH	(2007; 5th Ed) Brazing Handbook
AWS Z49.1	(2005) Safety in Welding and Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

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 B31.1	(2007; Addenda a 2008; Addenda b 2009) Power Piping
ASME B31.5	(2010) Refrigeration Piping and Heat

	Transfer Components
ASME B40.100	(2005) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

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	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 280	(2008) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 32	(2008) Standard Specification for Solder Metal
ASTM B 62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 75	(2002) Standard Specification for Seamless Copper Tube
ASTM B 813	(2010) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM D 3308	(2006) PTFE Resin Skived Tape
ASTM D 520	(2000; R 2005) Zinc Dust Pigment
ASTM E 84	(2010) Standard Test Method for Surface Burning Characteristics of Building Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Refrigerant Piping System; G

Drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

a. Piping layouts which identify all valves and fittings.

b. Plans and elevations which identify clearances required for maintenance and operation.

SD-03 Product Data

Refrigerant Piping System

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include in the data manufacturer's recommended installation instructions and procedures. Provide data for the following components as a minimum:

a. Piping and Fittings

b. Valves

c. Piping Accessories

d. Pipe Hangers, Inserts, and Supports

Spare Parts

Spare parts data for each different item of equipment specified in Army projects only.

Qualifications; G

4 copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations.

Refrigerant Piping Tests; G

A schedule, at least 2 weeks prior to the start of related testing, for each test. Identify the proposed date, time, and location for each test.

Demonstrations; G

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

SD-06 Test Reports

Refrigerant Piping Tests

Six copies of the report in bound 8 1/2 by 11 inch booklets documenting all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

SD-07 Certificates

Service Organization; G

A certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-10 Operation and Maintenance Data

Maintenance
Operation and Maintenance Manuals

Data Package 2 in accordance with Section 01 78 23.00 25 OPERATION AND MAINTENANCE DATA.

Six complete copies of an operation manual in bound 8 1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Six complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping layouts and simplified wiring and control diagrams of the system as installed.

1.3 QUALITY ASSURANCE

1.3.2 Contract Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation is the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

1.5 MAINTENANCE

1.5.1 General

Operation and maintenance data shall comply with the requirements of Section 01 78 23.00 25 OPERATION AND MAINTENANCE DATA and as specified herein.

1.5.2 Extra Materials

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

b. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. 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 tests, can be shown.

c. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

d. Exposed equipment moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

2.2 ELECTRICAL WORK

Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Field wiring shall be in accordance with manufacturer's instructions. 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.

2.3 REFRIGERANT PIPING SYSTEM

Refrigerant piping, valves, fittings, and accessories shall be in accordance with ANSI/ASHRAE 15 & 34 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories shall be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service shall be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant.

2.4 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

2.4.3 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inchand smaller may be flared. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

2.4.4 Solder

Solder shall conform to ASTM B 32, grade Sb5, tin-antimony alloy for service pressures up to 150 psig. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

2.4.5 Brazing Filler Metal

Filler metal shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.5 VALVES

Valves shall be designed, manufactured, and tested specifically for refrigerant service. Valve bodies shall be of brass, bronze, steel, or ductile iron construction. Valves shall have brazed or socket welded connections. Threaded end connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts shall be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere shall be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow

shall be legibly and permanently indicated on the valve body. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

2.5.1 Refrigerant Stop Valves

Valve shall be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing shall be replaceable under line pressure. Valve shall be provided with a wrench operator and a seal cap. Valve shall be the straight or angle pattern design as indicated.

2.5.2 Check Valves

Valve shall be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve shall be provide with resilient seat.

2.5.4 Expansion Valves

Valve shall conform to ANSI/AHRI 750 and ASHRAE 17. Valve shall be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicted or for constant evaporator loads.

2.5.5 Safety Relief Valves

Valve shall be the two-way type, unless indicated otherwise. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

2.5.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

2.5.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with AHRI 720.

2.6 PIPING ACCESSORIES

2.6.2 Sight Glass and Liquid Level Indicator

2.6.2.1 Assembly and Components

Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.

2.6.2.2 Gauge Glass

Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

2.6.2.3 Bull's-Eye and Inline Sight Glass Reflex Lens

Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlighted viewing shall be provided.

2.6.2.4 Moisture Indicator

Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

2.6.4 Flexible Pipe Connectors

Connector shall be a composite of interior corrugated phosphor bronze or Type 300 Series stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly shall be constructed with a safety factor of not less than 4 at300 degrees F. Unless otherwise indicated, the length of a flexible connector shall be as recommended by the manufacturer for the service intended.

2.6.6 Pressure and Vacuum Gauges

Gauges shall conform to ASME B40.100 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 3-1/2 inches in diameter with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.6.7 Temperature Gauges

Temperature gauges shall be the industrial duty type and be provided for the required temperature range. Gauges shall have Fahrenheit scale in 2

degrees graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 5 to 7 feet above the finished floor. Remote element type temperature gauges shall be provided in thermal wells located 7 feet above the finished floor.

2.6.7.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.6.7.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

2.6.7.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.6.7.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

2.6.8 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MSS SP-58 and MSS SP-69.

2.6.9 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.7 FABRICATION

2.7.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and

no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.7.2 Factory Applied Insulation

Refrigerant suction lines between the cooler and each compressor and cold gas inlet connections to gas cooled motors shall be insulated with not less than 3/4 inch thick unicellular plastic foam. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform a verification of dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

3.2.1 Directional Changes

Changes 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 weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

3.2.2 Functional Requirements

Piping shall be installed 1/2 inch/10 feet of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep

moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

3.2.3 Fittings and End Connections

3.2.3.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.2.3.2 Brazed Connections

Brazing shall be performed in accordance with AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Piping shall be supported prior to brazing and not be sprung or forced.

3.2.3.4 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.2.4 Valves

3.2.4.1 General

Refrigerant stop valves shall be installed on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Stop valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensable gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

3.2.4.2 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve

bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

3.2.4.3 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

3.2.8 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of all filter dryers and where indicated. Site glasses shall be full line size.

3.2.10 Accumulator

Accumulators shall be provided in the suction line to each compressor.

3.2.11 Flexible Pipe Connectors

Connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required.

3.2.12 Temperature Gauges

Temperature gauges shall be located specifically on, but not limited to the following: the sensing element of each automatic temperature control device where a thermometer is not an integral part thereof and the suction line at each evaporator or liquid cooler. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch.

3.2.13 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. 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.

3.2.13.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.2.13.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.2.13.3 C-Clamps

C-clamps shall be torqued in accordance with MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.2.13.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.2.13.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

3.2.13.6 Horizontal Pipe Supports

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. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.

3.2.13.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet not more than 8 feet from end of risers, and at vent terminations.

3.2.13.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.2.13.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and

larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.2.13.10 High Temperature Guides with Cradles

Where there are high system temperatures and welding to piping is not desirable, then 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.

3.2.13.11 Multiple Pipe Runs

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.

3.2.13.13 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. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section.

3.2.14 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.2.16 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53/A 53M, Standard weight. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

3.2.16.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed.

3.2.16.3 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

a. Waterproofing Clamping Flange: 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. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. 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 rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.2.16.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.2.18 Field Applied Insulation

Field installed insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.20 Identification Tags

Provide identification tags made of brass, engraved laminated plastic or engraved anodized aluminum indicating service and item number on all valves and dampers. 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.

3.3 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter shall be considered contaminated systems. Restoring contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, shall be performed using currently approved refrigerant and refrigeration manufacturer's procedures. Restoring contaminated systems shall be at no additional cost to the Government as determined by the Contracting Officer. Water shall not be used in any procedure or test.

3.5 REFRIGERANT PIPING TESTS

After all components of the refrigerant system have been installed and connected, subject the entire refrigeration system to pneumatic, evacuation, and startup tests as described herein. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test. Provide the services of a qualified technician, as required, to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.5.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

3.5.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ANSI/ASHRAE 15 & 34 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If

the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

3.5.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

3.5.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

3.5.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.5.6 Contractor's Responsibility

At all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

-- End of Section --

SECTION 23 31 13

METAL DUCTS
02/09

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	(2011) Steel Construction Manual
ANSI/AISC 360	(2005) Specification for Structural Steel Buildings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE EQUIP IP HDBK	(2008; Errata 1 2010) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE FUN IP	(2009; Errata 2010) Fundamentals Handbook, I-P Edition

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2004) Specification for Filler Metals for Brazing and Braze Welding

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(2010) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2009; Errata 09-1) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1966	(2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition
SMACNA 1987	(2006) HVAC Duct Systems Inspection Guide, 3rd Edition

UNDERWRITERS LABORATORIES (UL)

UL 181	(2005; R 2008) Factory-Made Air Ducts and Air Connectors

1.2 DESIGN REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS apply to work specified in this section.

Submit Equipment and Performance Data for medium/high pressure ductwork systems consisting of use life, system functional flows, safety features, and mechanical automated details. Submit test response and performance characteristics curves for certified equipment.

Submit Design Analysis and Calculations for medium/high pressure ductwork systems indicating the manufacturer's recommended air velocities, maximum static pressure, and temperature calculations.

1.3 SCOPE OF WORK

Encompass low-pressure systems ductwork and plenums where maximum air velocity is 2,000 feet per minute(fpm) and maximum static pressure is 2 inches water gage (wg), positive or negative.

Submit Connection Diagrams for low pressure ductwork systems indicating the relation and connection of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Design Analysis and Calculations for low pressure ductwork systems indicating the manufacturer's recommended air velocities, maximum static pressures, temperature calculations and acoustic levels.

Encompass high velocity systems ductwork where:

Minimum air velocity exceeds 2,000 feet per minute (fpm) or static pressure exceeds 2 inches water gage (wg).

Do not use rigid fibrous-glass ductwork.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists and Records of Existing Conditions in accordance with paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Submit the following in accordance with paragraph entitled, "Drawings," of this section.

Connection Diagrams
Record Drawings

SD-03 Product Data

Submit Equipment and Performance Data for medium/high pressure ductwork systems in accordance with paragraph entitled, "Design Requirements," of this section.

Submit manufacturer's catalog data for the following items:

Galvanized Steel Ductwork Materials
Brazing Materials
Mill-Rolled Reinforcing and Supporting Materials
Round Sheet Metal Duct Fittings
Turning Vanes
Flexible Connectors
Flexible Duct Materials
Flexible Connectors
Gravity Backdraft and Relief Dampers
Manual Volume Dampers

SD-05 Design Data

Submit Design Analysis and Calculations for medium/high pressure ductwork systems in accordance with paragraph entitled, "Design Requirements," of this section.

SD-06 Test Reports

Submit test reports for medium/high pressure ductwork systems in accordance with the paragraphs entitled, "Ductwork Leakage Tests" and "Fire Damper Tests," of this section.

Ductwork Leakage Tests
Operational Tests

SD-07 Certificates

Listing of Product Installations for medium/high pressure ductwork systems in accordance with paragraph entitled, "Installation," of this section.

Submit certificates, showing conformance with the referenced standards contained in this section for:

Galvanized Steel Ductwork Materials
Brazing Materials
Mill-Rolled Reinforcing and Supporting Materials

Round Sheet Metal Duct Fittings
Turning Vanes
Dampers
Flexible Connectors

1.5 GENERAL REQUIREMENTS

Submit Records of Existing Conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

Include the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information within Material, Equipment, and Fixture Lists.

1.6 DRAWINGS

Submit Connection Diagrams for medium/high pressure ductwork systems indicating the relation and connection of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Provide Record Drawings with current factual information including deviations from, and amendments to, the drawings and concealed or visible changes in the work, for medium/high pressure ductwork systems.Label drawings "As-Built".

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Ductwork Materials

Galvanized steel ductwork sheet metal shall be carbon steel, of lock-forming quality, hot-dip galvanized, with regular spangle-type zinc coating, conforming to ASTM A 924/A 924M and ASTM A 653/A 653M, Designation G90. Treat duct surfaces to be painted by phosphatizing.

Conform to ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966 for sheet metal gages and reinforcement thickness.

Low pressure ductwork minimum standards are as follows:

MINIMUM SHEET METAL GAGE

DUCT WIDTH INCHES	GAGE
0 - 12	26
13 - 30	24
31 - 60	22

2.1.2 Brazing Materials

Brazing materials shall be silicon bronze conforming to AWS A5.8/A5.8M.

2.1.3 Mill-Rolled Reinforcing And Supporting Materials

Conform to ASTM A 36/A 36Mfor mill-rolled structural steel and, wherever in contact with sheet metal ducting galvanize to commercial weight of zinc or coated with materials conforming to ASTM A 123/A 123M.

Equivalent strength, proprietary design, rolled-steel structural support systems may be submitted for approval in lieu of mill-rolled structural steel.

2.2 COMPONENTS

2.2.1 Round Sheet Metal Duct Fittings

Shop fabricate fittings.

Manufacture as separate fittings, not as tap collars welded or brazed into duct sections.

Submit for approval offset configurations.

Miter elbows shall be two-piece type for angles less than 31 degrees, three-piece type for angles 31 through 60 degrees, and five-piece type for angles 61 through 90 degrees. Centerline radius of elbows shall be 1-1/2 times fitting cross section diameter.

Crosses, increasers, reducers, reducing tees, and 90-degree tees shall be conical type.

Cutouts in fitting body shall be equal to branch tap dimension or, where smaller, excess material shall be flared and rolled into smooth radius nozzle configuration.

2.2.3 Reinforcement

Support inner liners of both duct and fittings by metal spacers welded in position to maintain spacing and concentricity.

2.2.4 Fittings

Make divided flow fittings as separate fittings, not tap collars into duct sections, with the following construction requirements:

Sound, airtight, continuous welds at intersection of fitting body and tap

Tap liner securely welded to inner liner, with weld spacing not to exceed 3 inches

Pack insulation around the branch tap area for complete cavity filling.

Carefully fit branch connection to cutout openings in inner liner without spaces for air erosion of insulation and without sharp projections that cause noise and airflow disturbance.

Continuously braze seams in the pressure shell of fittings. Protect galvanized areas that have been damaged by welding with manufacturer's standard corrosion-resistant coating.

Submit for approval offset configurations.

Elbows shall be two-piece type for angles through 35 degrees, three-piece type for angles 36 through 71 degrees, and five-piece type for angles 72 through 90 degrees.

Crosses, increasers, reducers, reducing tees, and 90-degree tees shall be conical type.

2.2.5 Turning Vanes

Turning vanes shall be double-wall type, commercially manufactured for high-velocity system service.

2.2.6 Dampers

Low pressure drop, high-velocity manual volume dampers, and high-velocity fire dampers shall be constructed in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

2.2.8 Flexible Connectors For Sheet Metal

Connectors shall be UL listed, 30-ounce per square foot, waterproof, fire-retardant, airtight, woven fibrous-glass cloth, double coated with chloroprene. Clear width, not including clamping section, shall be 6 to 8 inches.

2.2.9 Duct Hangers

Duct hangers in contact with galvanized duct surfaces shall be galvanized steel painted with inorganic zinc.

2.2.10 Mill-Rolled Reinforcing And Supporting Materials

Mill-rolled structural steel shall conform to ASTM A 36/A 36M and, whenever in contact with sheet metal ducting, shall be galvanized in accordance with ASTM A 123/A 123M.

Equivalent strength, proprietary-design, rolled-steel structural support systems may be submitted for approval in lieu of mill-rolled structural steel.

2.2.11 Flexible Duct Materials

Flexible duct connectors shall be in accordance with UL 181, Class 1 material and shall comply with NFPA 90A.

2.2.12 Manual Volume Dampers

Conform to SMACNA 1966 for volume damper construction.

Equip dampers with an indicating quadrant regulator with a locking feature externally located and easily accessible for adjustment and standoff brackets to allow mounting outside external insulation. Where damper rod lengths exceed 30 inches, provide a regulator at each end of damper shaft.

All damper shafts shall have two-end bearings.

Damper shaft shall be full length and shall extend beyond damper blade. A 3/8 inch square shaft shall be used for damper lengths up to 20 inches and a 1/2 inch square shaft shall be used for damper lengths 20 inches and larger. Where necessary to prevent damper vibration or slippage, adjustable support rods with locking provisions external to duct shall be provided at damper blade end.

Dampers in ducts having a width perpendicular to the axis of the damper that is greater than 12 inches shall be multiblade type having a substantial frame with blades fabricated of 16-gage metal. Blades shall not exceed 10 inches in width and 48 inches in length and shall be pinned to 1/2 inch diameter shafts. Dampers greater than 48 inches in width shall be made in two or more sections with intermediate mullions, each section being mechanically interlocked with the adjoining section or sections. Blades shall have graphite-impregnated nylon bearings and shall be connected so that adjoining blades rotate in opposite directions.

2.2.13 Gravity Backdraft And Relief Dampers

Frame shall be constructed of not less than 1-1/2- by 4 inch reinforced 16 -gage galvanized carbon steel. Frames and mullions shall be solidly secured in place and sealed with elastomer calking against air bypass.

Maximum blade width shall be 9 inches, and maximum blade length shall be 36 inches. Blade material shall be 16-gage galvanized steel. Blades shall be provided with mechanically retained seals and 90-degree limit stops.

Dampers used for relief service shall have blades linked together to open not less than 30 degrees on 0.05 inch wg differential pressure.

Shaft bearings shall be graphite-impregnated nylon.

Counterbalanced dampers shall be equipped with fixed or adjustable counterbalancing weights.

Gravity backdraft dampers in sizes 18 by 18 inches or smaller, when furnished integral with air moving equipment, may be equipment manufacturer's standard construction.

PART 3 EXECUTION

3.1 PREPARATION

Provide sheet metal construction in accordance with the recommendations for best practices in ASHRAE EQUIP IP HDBK, Chapter 16, SMACNA 1966, NFPA 90A, and ASHRAE FUN IP, Chapter 32.

Where construction methods for certain items are not described in the referenced standards or herein, perform the work in accordance with recommendations for best practice defined in ASHRAE EQUIP IP HDBK.

Clean free of oil, grease, and deleterious substances sheet metal surfaces to be painted and surfaces to which adhesives are to be applied.

Duct strength shall be adequate to prevent failure under service pressure or vacuum created by fast closure of duct devices. Provide leaktight, automatic relief devices.

Supplementary steel shall be designed and fabricated in accordance with

ANSI/AISC 360 and AISC 325.

3.2 INSTALLATION

Within Listing of Product Installations for medium/high pressure ductwork systems include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Include purchaser, address of installation, service organization, and date of installation.

Fabricate airtight and include reinforcements, bracing, supports, framing, gasketing, sealing, and fastening to provide rigid construction and freedom from vibration, airflow-induced motion and noise, and excessive deflection at specified maximum system air pressure and velocity.

Enclose dampers located behind architectural intake or exhaust louvers by a rigid sheet metal collar and sealed to building construction with elastomers for complete air tightness.

Provide outside air-intake ducts and plenums made from sheet metal with soldered watertight joints.

Provide offsets and transformations as required to avoid interference with the building construction, piping, or equipment.

Wherever ducts pass through firewalls or through walls or floors dividing conditioned spaces from unconditioned spaces, provide a flanged segment in that surface during surface construction.

Clean free of oil, grease, and deleterious substances sheet metal surfaces to be painted or surfaces to which adhesives will be applied.

Where interiors of ducting may be viewed through air diffusion devices, construct the viewed interior with sheet metal and paint flat black.

Make plenum anchorage provisions, sheet metal joints, and other areas airtight and watertight by calking mating galvanized steel and concrete surfaces with a two-component elastomer.

3.3 APPLICATION

3.3.1 Low Pressure Sheet Metal Ducts

Standard seam joints shall be sealed with an elastomer compound to comply with SMACNA 1966 Seal Class A, B or C as applicable.

Crossbreaking shall be limited to 4 feet and shall be provided on all ducts 8 inches wide and wider. Bead reinforcement shall be provided in lieu of crossbreaking where panel popping may occur. Where rigid insulation will be applied, crossbreaking is not required.

3.3.1.1 Longitudinal Duct Seams

Corner seams shall be Pittsburg lock.

3.3.1.2 Joints and Gaskets

Companion angle flanges shall be bolted together with 1/4 inch diameter bolts and nuts spaced 6 inches on center. Flanged joints shall be

gasketed with chloroprene full-face gaskets 1/8 inch thick, with Shore A 40 durometer hardness. Gaskets shall be one piece and vulcanized at joints.

3.3.1.3 Flexible Duct Joints

Joints between flexible duct without sheet metal collars and round metal ductwork connections shall be made by trimming the ends, coating the inside of the flexible duct for a distance equal to depth of insertion with elastomer calk, and by securing with sheet metal screws or binding with a strap clamp.

3.3.1.4 Square Elbows

Provide single-vane duct turns in accordance with SMACNA 1966, and may be used on ducts 12 inches wide and narrower.

3.3.1.5 Radius Elbows

Conform to SMACNA 1966 for radius elbows. Provide an inside radius equal to the width of the duct. Where installation conditions preclude use of standard elbows, the inside radius may be reduced to a minimum of 0.25 times duct width and install turning vanes in accordance with the following schedule.

WIDTH OF ELBOWS INCHES	RADIUS OF TURNING VANES IN PERCENT OF DUCT WIDTH VANE NO. 1	VANE NO. 2	VANE NO. 3
Up to 16	56	--	--
17 to 48	43	73	--

Where two elbows are placed together in the same plane in ducts 30 inches wide and larger, the guide vanes shall be continuous through both elbows rather than spaced in accordance with above schedule.

3.3.1.6 Outlets, Inlets, And Duct Branches

Install branches, inlets, and outlets so that air turbulence will be reduced to a minimum and air volume properly apportioned. Install adjustable splitter dampers at all supply junctions to permit adjustment of the amount of air entering the branch. Wherever an air-diffusion device is shown as being installed on the side, top, or bottom of a duct, and whenever a branch takeoff is not of the splitter type, a commercially manufactured 45 degree side-take-off (STO) fitting with manual; provide volume damper to allow adjustment of the air quantity and to provide an even flow of air across the device or duct it services.

Where a duct branch is to handle more than 25 percent of the air handled by the duct main, use a complete 90-degree increasing elbow with an inside radius of 0.75 times branch duct width. Size of the leading end of the increasing elbow within the main duct shall have the same ratio to the main duct size as the ratio of the related air quantities handled.

Where a duct branch is to handle 25 percent or less of the air handled by the duct main, the branch connection shall have a 45 degree side take-off entry in accordance with SMACNA 1966.

3.3.1.7 Duct Transitions

Where the shape of a duct changes, the angle of the side of the transition piece shall not exceed 15 degrees from the straight run of duct connected thereto.

Where equipment is installed in ductwork, the angle of the side of the transition piece from the straight run of duct connected thereto shall not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3.1.8 Branch Connections

Construct radius tap-ins in accordance with SMACNA 1966.

3.3.1.9 Access Openings

Install access doors and panels in ductwork at controls or at any item requiring periodic inspection, adjustment, maintenance, or cleaning, and every 20 feet 6.1M for indoor air quality housekeeping purposes.

Minimum size of access opening shall be 12 by 18 inches , unless precluded by duct dimensions or otherwise indicated.

Construct access door in accordance with SMACNA 1966, except that sliding doors may be used only for special conditions upon prior approval. Insulated doors shall be double-panel type.

Access doors that leak shall be made airtight by adding or replacing hinges and latches or by construction of new doors adequately reinforced, hinged, and latched.

3.3.1.11 Manual Volume Dampers

Balancing dampers of the splitter, butterfly, or multilouver type, shall be provided to balance each respective main and branch duct.

Dampers regulated through ceilings shall have regulator concealed in box mounted in the ceiling, with a cover finish aesthetically compatible with ceiling surface. Where ceiling is of removable construction, regulators shall be above ceiling, and location shall be marked on ceiling in a manner acceptable to the Contracting Officer.

3.3.1.12 Flexible Connectors For Sheet Metal

Air handling equipment, ducts crossing building expansion joints, and fan inlets and outlets shall be connected to upstream and downstream components by treated woven-cloth connectors.

Connectors shall be installed only after system fans are operative, and vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkle caused by misalignment or fan reaction. Width of surface shall be curvilinear.

3.3.2 Rectangular Sheet Metal Ducts

3.3.3 Round Sheet Metal Ducts

3.3.3.1 Duct Gages, Joints, And Reinforcement

Sheet metal minimum thickness, joints, and reinforcement between joints shall be in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

Longitudinal duct joint shall be manufactured by machine, with spiral lockseams to and including 60 inch diameters, and to dimensional tolerances compatible with fittings provided.

Draw band girth joints are not acceptable.

Slip joints shall be made up by coating the male fitting with elastomer sealing materials, exercising care to prevent mastic from entering fitting bore, leaving only a thin annular mastic line exposed internally. Sheet metal screws shall be used to make assembly rigid, not less than four screws per joint, maximum spacing 6 inches. Pop rivets shall not be used. All joints shall be taped and heat sealed.

Bolt heads and nuts shall be hex-shaped, 5/16 inch diameter for ducts up to 50 inch diameter, and 3/8 inch diameter for 51 inch diameter ducts and larger.

3.3.3.2 Duct Transitions

Where the shape of a duct changes, the angle of the side of the transition piece shall not exceed 15 degrees from the straight run of duct connected thereto.

Where equipment is installed in ductwork, the angle of the side of the transition piece from the straight run of duct connected thereto shall not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3.7 Radius Elbows

Fabricate elbow proportions and radius elbows in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

3.3.8 Plenum Connections

Round duct connections shall be welded joint bellmouth type.

Rectangular duct connections shall be bellmouth type, constructed in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

3.3.9 Access Openings

Install access panels in ductwork adjacent to fire dampers.

Minimum size of access opening shall be 12 by 18 inches, unless precluded by duct dimension.

In lieu of access doors, readily accessible flanged duct sections may be

provided upon approval. Provide stable hanger supports for disconnected duct termini.

3.3.10 Duct Supports

Install duct support in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Duct hangers shall meet the minimum size specified in ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Provide two hangers where necessary to eliminate sway.

Selection of hanging system shall be at the Contractor's option, and shall take into account the location and precedence of work under other sections, interferences of various piping and electrical conduit, equipment, building configuration, structural and safety factor requirements, vibration, and imposed loads under normal and abnormal service conditions. Support sizes, configurations, and spacings are given to show the minimal type of supporting components required. If installed loads are excessive for the specified hanger spacing, hangers, and accessories hanger spacing shall be reduced. After system startup, any duct support device which, due to length, configuration, or size, vibrates or causes possible failure of a member, shall be replaced or the condition shall otherwise be alleviated. Special care shall be exercised to preclude cascade-type failures.

Hanger rods, angles, and straps shall be attached to beam clamps. Concrete inserts, masonry anchors, and fasteners shall be approved for the application.

Hanger spacing shall provide a 20-to-1 safety factor for supported load.

Maximum load supported by any two fasteners shall be 100 pounds.

Friction rod assemblies are not acceptable.

Where support from metal deck systems is involved, support requirements shall be coordinated with installation of metal deck.

Ductwork and equipment shall not be hung from roof deck, piping, or other ducts or equipment. Maximum span between any two points shall be 10 feet, with lesser spans as required by duct assemblies, interferences, and permitted loads imposed.

There shall be not less than one set of hangers for each point of support. Hangers shall be installed on both sides of all duct turns, branch fittings, and transitions.

Hangers shall be sufficiently cross braced to eliminate sway vertically and laterally.

Rectangular ducts up to 36 inches shall be supported by strap-type hangers attached at not less than three places to not less than two duct surfaces in different planes.

Perforated strap hangers are not acceptable.

Rectangular ducting, 36 inches and larger, shall be supported by trapeze hangers. Ducts situated in unconditioned areas and required to have insulation with a vapor-sealed facing shall be supported on trapeze hangers. Hangers shall be spaced far enough out from the side of the duct

to permit the duct insulation to be placed on the duct inside the trapeze. Duct hangers shall not penetrate the vapor-sealed facing.

Where trapeze hangers are used, the bottom of the duct shall be supported on angles sized as follows:

WIDTH OF DUCT, INCHES	MINIMUM BOTTOM ANGLE SIZE, INCHES
30 and smaller	1-1/4 by 1-1/4 by 1/8
31 to 48	1-1/2 by 1-1/2 by 1/8

Where ductwork system contains heavy equipment, excluding air-diffusion devices and single-leaf dampers, such equipment shall be hung independently of the ductwork by means of rods or angles of sizes adequate to support the load.

Ducting, when supported from roof purlins, shall not be supported at points greater than one-sixth of the purlin span from the roof truss. Load per hanger shall not exceed 400 pounds when support is from a single purlin or 800 pounds when hanger load is applied halfway between purlins by means of auxiliary support steel provided under this section. When support is not halfway between purlins, the allowable hanger load shall be the product of 400 times the inverse ratio of the longest distance to purlin-to-purlin spacing.

When the hanger load exceeds the above limits, provide reinforcing of purlin(s) or additional support beam(s). When an additional beam is used, the beam shall bear on the top chord of the roof trusses, and bearing shall be over gusset plates of top chord. Beam shall be stabilized by connection to roof purlin along bottom flange.

Purlins used for supporting fire-protection sprinkler mains, electrical lighting fixtures, electrical power ducts, or cable trays shall be considered fully loaded, and supplemental reinforcing or auxiliary support steel shall be provided for these purlins.

Provide vibration isolators in discharge ducting system for a distance not less than 50 feet beyond the air handling unit. Deflection of duct and equipment mountings shall be coordinated.

3.3.11 Flexible Connectors For Steel Metal

Air-handling equipment, ducts crossing building expansion joints, and fan inlets and outlets shall be connected to upstream and downstream components by treated woven-cloth connectors.

Install connectors only after system fans are operative and all vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkles caused by misalignment or fan reaction. Width of surface shall be curvilinear.

3.3.12 Insulation Protection Angles

Galvanized 20-gage sheet, formed into an angle with a 2 inch exposed long leg with a 3/8 inch stiffening break at outer edge, and with a variable concealed leg, depending upon insulation thickness, shall be provided.

Install angles over all insulation edges terminating by butting against a

wall, floor foundation, frame, and similar construction. Fasten angles in place with blind rivets through the protection angle, insulation, and sheet metal duct or plenum. Install angles after final insulation covering has been applied.

3.3.13 Duct Probe Access

Provide holes with neat patches, threaded plugs, or threaded or twist-on caps for air-balancing pitot tube access. Provide extended-neck fittings where probe access area is insulated.

3.3.14 Openings In Roofs And Walls

Building openings are fixed and provide equipment to suit.

3.4 FIELD QUALITY CONTROL

3.4.2 Ductwork Leakage Tests

Contractor shall conduct complete leakage test of new ductwork in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Tests shall be performed prior to installing ductwork insulation.

3.4.3 Inspection

Ductwork shall be inspected in accordance with SMACNA 1987.

3.5 DUCTWORK CLEANING PROVISIONS

Open ducting shall be protected from construction dust and debris in a manner approved by the Contracting Officer. Dirty assembled ducting shall be cleaned by subjecting all main and branch interior surfaces to airstreams moving at velocities two times specified working velocities, at static pressures within maximum ratings. This may be accomplished by: filter-equipped portable blowers which remain the Contractor's property; wheel-mounted, compressed-air operated perimeter lances which direct the compressed air and which are pulled in the direction of normal airflow; and other means approved by the Contracting Officer. Compressed air used for cleaning ducting shall be water- and oil- free. After construction is complete, and prior to acceptance of the work, construction dust and debris shall be removed from exterior surfaces. SMACNA 1987.

3.6 OPERATION AND MAINTENANCE

Contractor shall submit 6 copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the medium/high pressure ductwork systems. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

-- End of Section --

SECTION 23 37 13.00 40

DIFFUSERS, REGISTERS, AND GRILLS
05/10

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 within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 113	(2009) Method of Testing for Room Air Diffusion
ASHRAE EQUIP IP HDBK	(2008; Errata 1 2010) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE FUN IP	(2009; Errata 2010) Fundamentals Handbook, I-P Edition

1.2 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

1.3 PERFORMANCE REQUIREMENTS

Certify air diffusion devices having been tested and rated in accordance with ASHRAE EQUIP IP HDBK, Chapter 17; ASHRAE FUN IP, Chapter 31; and ASHRAE 113, where such certification is required.

Submit equipment and performance data for air-diffusion devices consisting of sound data in terms of Noise Criteria (NC) index for the capacity range of the device.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit the following in accordance with this section.

Material, Equipment, and Fixture Lists; G

Records of Existing Conditions; G

SD-02 Shop Drawings

Submit Fabrication Drawings; G for air-diffusion devices in

accordance with this section.

Submit Installation Drawings; G for air-diffusion devices in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Submit Equipment and Performance Data; G for air-diffusion devices in accordance with paragraph entitled, "Performance Requirements," of this section.

PART 2 PRODUCTS

2.1 AIR-DIFFUSION DEVICE CONSTRUCTION

Preclude flutter, rattle, or vibration on air-diffusion device construction and mounting. Modify devices and provide accessories necessary for mounting in indicated surface construction.

Provide color as indicated on drawings.

Provide supply diffusers with combination damper and equalizing grid. Ensure dampers are extracting-splitter type, except as otherwise indicated.

Ensure air-diffusion device volume and pattern adjustments can be made from the face of the device. Make volume adjustments by removable key.

Provide gaskets for supply-terminal air devices mounted in finished surfaces.

Include within the material, equipment, and fixture lists the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Submit records of existing conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

Submit fabrication drawings for air-diffusion devices consisting of fabrication and assembly details to be performed in the factory.

2.2 TYPES OF AIR-DIFFUSION DEVICES

2.2.10 Type GS

Provide type GS supply grill double deflection type with adjustable face bars parallel to short dimension and adjustable rear bars parallel to long dimension.

Provide aluminum construction.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment as indicated and specified and in accordance with

manufacturer's recommendations.

Submit installation drawings for air-diffusion devices. Indicate on drawings overall physical features, dimensions, ratings, service requirements, and equipment weights.

3.1.1 Operations and Maintenance Manuals

Provide operation and maintenance manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 82 02.00 10

UNITARY HEATING AND COOLING EQUIPMENT
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.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 540	(2004) Performance Rating Of Positive Displacement Refrigerant Compressors And Compressor Units
AHRI 700	(2006; Addendum 1 2009) Specifications for Fluorocarbon Refrigerants
ANSI/AHRI 340/360	(2007) Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
ANSI/AHRI 460	(2005) Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ANSI/AHRI 495	(2005) Performance Rating of Refrigerant Liquid Receivers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34	(2010; Std 15 Addenda a, b, d; Std 34 Addenda a, b, d) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 52.1	(1992; Interpretation 1 2007) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	(2005) Safety in Welding and Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications

ASME BPVC SEC VIII D1	(2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM C 1071	(2005e1) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D 520	(2000; R 2005) Zinc Dust Pigment
ASTM E 84	(2010) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 104	(2003; R 2009) Standard Classification System for Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2011) Enclosures
NEMA MG 1	(2009) Motors and Generators
NEMA MG 2	(2001; Rev 1 2007) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013;Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1995	(2005; R 2009) Heating and Cooling Equipment
UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units
UL 900	(2004; R 2007; R 2009) Standard for Air Filter Units

1.2 SYSTEM DESCRIPTION

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be the premium efficiency type in accordance with NEMA MG 1. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. 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. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. 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.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings

Drawings provided in adequate detail to demonstrate compliance with contract requirements, as specified.

SD-03 Product Data

Materials and Equipment

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, vibration isolator literature shall be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Data shall be submitted for each specified component.

Spare Parts

Spare parts data for each different item of equipment specified.

Posted Instructions

Posted instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, confirmation of existing conditions, and any discrepancies found.

Coil Corrosion Protection

Product data on the type coating selected, the coating thickness, the application process used, the estimated heat transfer loss of the coil, and verification of conformance with the salt spray test requirement.

System Performance Tests

A schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules shall identify the proposed date, time, and location for each test.

Demonstrations; G

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

SD-06 Test Reports

Refrigerant Tests, Charging, and Start-Up; G

Six copies of each test containing the information described below in bound 8-1/2 by 11 inch booklets. Individual reports shall be submitted for the refrigerant system tests.

a. The date the tests were performed.
b. A list of equipment used, with calibration certifications.
c. Initial test summaries.
d. Repairs/adjustments performed.
e. Final test results.

System Performance Tests; G

Six copies of the report provided in bound 8-1/2 by 11 inch booklets. The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system.

SD-07 Certificates

Materials and Equipment

Where the system, components, or equipment are specified to comply with requirements of AHRI, ASHRAE, ASME, or UL, proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, 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 may be submitted. When performance requirements of this project's drawings and specifications vary from standard AHRI rating conditions, computer printouts, catalog, or other application data certified by AHRI or a nationally recognized laboratory as described above shall be included. If AHRI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

Service Organization

A certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Six complete copies of an operation manual in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features. Six complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

1.4 QUALITY ASSURANCE

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Submit drawings consisting of:

a. Equipment layouts which identify assembly and installation details.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.

d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.

e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

f. Automatic temperature control diagrams and control sequences.

g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.

1.5 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide Materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The 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 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. 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 tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

2.1.2 Nameplates

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.1.3 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

2.4 UNITARY EQUIPMENT, SPLIT SYSTEM

Unit shall be an air-cooled, split system which employs a remote condensing unit, a separate indoor unit, and interconnecting refrigerant piping. Unit shall be the heat pump type conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit shall be rated in accordance with ANSI/AHRI 340/360. Unit shall be provided with necessary fans, air filters, liquid receiver, internal dampers, mixing boxes, supplemental heat, and cabinet construction as specified in paragraph "Unitary Equipment Components". The remote unit shall be as specified in paragraph REMOTE CONDENSER OR CONDENSING UNIT. Evaporator or supply fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type. Condenser or outdoor fans shall be the manufacturer's standard for the unit specified and may be either propeller or centrifugal scroll type. Fan and condenser motors shall have totally enclosed enclosures.

2.4.1 Air-to-Refrigerant Coil

Coils shall have copper or aluminum tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coil shall be protected in accordance with paragraph COIL CORROSION PROTECTION. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ANSI/ASHRAE 15 & 34 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.4.2 Compressor

Compressor shall be direct drive, semi-hermetic or hermetic reciprocating, or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. Compressors of 10 tons and larger shall be provided with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with

unloading capabilities, in which case the compressors will operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Each compressor shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads,high and low pressure safety cutoffs and protection against short cycling.

2.4.3 Refrigeration Circuit

Refrigerant-containing components shall comply with ANSI/ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided for each circuit. Filter-drier shall be provided in each liquid line and be reversible-flow type. Refrigerant flow control devices shall be an adjustable superheat thermostatic expansion valve with external equalizer matched to coil, capillary or thermostatic control, and a pilot solenoid controlled, leak-tight, four-way refrigerant flow reversing valve. A refrigerant suction line thermostatic control shall be provided to prevent freeze-up in event of loss of water flow during heating cycle.

2.4.4 Unit Controls

Unit shall be internally prewired with a 120 volt control circuit powered by an internal transformer. Terminal blocks shall be provided for power wiring and external control wiring. Unit shall have cutoffs for high and low pressure, and low oil pressure for compressors with positive displacement oil pumps, supply fan failure, and safety interlocks on all service panels. Head pressure controls shall sustain unit operation with ambient temperature of 30 degrees F. Adjustable-cycle timers shall prevent short-cycling. Multiple compressors shall be staged by means of a time delay. Unit shall be internally protected by fuses or a circuit breaker in accordance with UL 1995. Low cost cooling shall be made possible by means of a control circuit which will modulate dampers to provide 100 percent outside air while locking out compressors.

2.5 REMOTE CONDENSER OR CONDENSING UNIT

Each remote condenser coil shall be fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature shall not exceed 120 degrees F at 95 degrees F ambient. Unit shall be provided with low ambient condenser controls to ensure proper operation in an ambient temperature of 30 degrees F. Fan and cabinet construction shall be provided as specified in paragraph "Unitary Equipment Components". Fan and condenser motors shall have totally enclosed enclosures.

2.5.1 Air-Cooled Condenser

Unit shall be rated in accordance with ANSI/AHRI 460 and conform to the requirements of UL 1995. Unit shall be factory fabricated, tested, packaged, and self-contained. Unit shall be complete with casing, propeller or centrifugal type fans, heat rejection coils, connecting piping and wiring, and all necessary appurtenances.

2.5.1.1 Connections

Interconnecting refrigeration piping, electrical power, and control wiring between the condensing unit and the indoor unit shall be provided as required and as indicated. Electrical and refrigeration piping terminal

connections between condenserand evaporator units shall be provided.

2.5.1.2 Head Pressure Control and Liquid Subcooling

Low ambient control for multi-circuited units serving more than one evaporator coil shall provide independent condenser pressure controls for each refrigerant circuit. Controls shall be set to produce a minimum of 95 degrees F saturated refrigerant condensing temperature. Unit shall be provided with a liquid subcooling circuit which shall ensure proper liquid refrigerant flow to the expansion device over the specified application range of the condenser. Unit shall be provide with manufacturer's standard liquid subcooling. Subcooling circuit shall be liquid sealed.

2.5.1.3 Condensing Coil

Coils shall have copper tubes of 3/8 inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Coil shall be protected in accordance with paragraph COIL CORROSION PROTECTION. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ANSI/ASHRAE 15 & 34 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged. Separate expansion devices shall be provided for each compressor circuit.

2.5.1.4 Unit Controls

The control system shall be complete with required accessories for regulating condenser pressure by fan cycling, solid-state variable fan speed, modulating condenser coil or fan dampers, flooding the condenser, or a combination of the above. Unit mounted control panels or enclosures shall be constructed in accordance with applicable requirements of NFPA 70 and housed in NEMA ICS 6, Class 1 or 3A enclosures. Controls shall include control transformer, fan motor starters, overload protective devices, interface with local and remote components, and intercomponent wiring to terminal block points.

2.5.3 Compressor

Unit shall be rated in accordance with AHRI 540. Compressor shall be direct drive, semi-hermetic or hermetic reciprocating, or scroll type capable of operating at partial load conditions. Compressor shall be capable of continuous operation down to the lowest step of unloading as specified. Units 120,000 Btuh and larger shall be provided with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors will operate in sequence, and each compressor shall have an independent refrigeration circuit through the condenser and evaporator. Each compressor shall start in the unloaded position. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, and high and low pressure safety cutoffs and protection against short cycling.

2.7 EQUIPMENT EFFICIENCY

Unit shall have an efficiency as indicated on the drawings.

2.8 UNITARY EQUIPMENT COMPONENTS

2.8.1 Refrigerant and Oil

Refrigerant shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ANSI/ASHRAE 15 & 34. Refrigerants shall meet the requirements of AHRI 700 as a minimum. Refrigerants shall have an Ozone Depletion Potential (ODP) of less than or equal to 0.05. Provide and install a complete charge of refrigerant for the installed system as recommended by the manufacturer. Lubricating oil shall be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge shall be in accordance with manufacturer's recommendation.

2.8.2 Fans

Fan wheel shafts shall be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans shall be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, shall be magnetic across-the-line type with a totally enclosed enclosure. Thermal overload protection shall be of the manual or automatic-reset type. Fan wheels or propellers shall be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings shall be of galvanized steel, and both centrifugal and propeller fan casings shall be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, shall be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting shall be recoated with an approved zinc-rich compound. Fan wheels or propellers shall be statically and dynamically balanced. Direct-drive fan motors shall be of the multiple-speed variety. Belt-driven fans shall have adjustable sheaves to provide not less than 150 percent fan-speed adjustment. The sheave size shall be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. Centrifugal scroll-type fans shall be provided with streamlined orifice inlet and V-belt drive. Each drive will be independent of any other drive. Propeller fans shall be direct-drive drive type with fixed pitch blades. V-belt driven fans shall be mounted on a corrosion protected drive shaft supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Each drive will be independent of any other drive. Drive bearings shall be protected with water slingers or shields. V-belt drives shall be fitted with guards where exposed to contact by personnel and fixed pitch sheaves.

2.8.3 Primary/Supplemental Heating

2.8.4 Air Filters

Air filters shall be listed in accordance with requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test Method shall be as listed under the label service and shall meet the requirements of UL 586.

2.8.4.2 Replaceable Media Filters

Replaceable media filters shall be the dry-media type, of the size required

to suit the application. Filtering media shall be not less than 2 inches thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Pad shall be enclosed in a holding frame of not less than 16 gauge galvanized steel, and equipped with quick-opening mechanism for changing filter media. The air flow capacity of the filter shall be based on net filter face velocity not exceeding 300 feet/minute, with initial resistance of 0.13 inches water gauge. Average efficiency shall be not less than 30 percent when tested in accordance with ASHRAE 52.1.

2.8.5 Coil Frost Protection

Each circuit shall be provided with a coil frost protection system which is a manufacturer's standard. The coil frost protection system shall use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Timers shall be used to prevent the compressor from rapid cycling.

2.8.6 Pressure Vessels

2.8.6.2 Liquid Receiver

A liquid receiver shall be provided when a system's condenser or compressor does not contain a refrigerant storage capacity of at least 20 percent in excess of a fully charged system. Receiver shall be designed, filled, and rated in accordance with the recommendations of ANSI/AHRI 495, except as modified herein. Receiver shall be fitted to include an inlet connection; an outlet drop pipe with oil seal and oil drain where necessary; two bull's-eye liquid level sight glass in same vertical plane, 90 degrees apart and perpendicular to axis of receiver or external gauge glass with metal guard and automatic stop valves; thermal well for thermostat; and purge, charge, equalizing, pressurizing, plugged drain and service valves on the inlet and outlet connections. Receiver shall be provided with a relief valve of capacity and setting in accordance with ANSI/ASHRAE 15 & 34.

2.8.7 Internal Dampers

Dampers shall be parallel blade type with renewable blade seals and be integral to the unitary unit. Damper provisions shall be provided for each outside air intake, exhaust, economizer, and mixing boxes. Dampers shall operate as specified.

2.8.9 Cabinet Construction

Casings for the specified unitary equipment shall be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Minimum thickness of single wall exterior surfaces shall be 18 gauge galvanized steel or 0.071 inch thick aluminum on units with a capacity above 20 tons and 20 gauge galvanized steel or 0.064 inch thick aluminum on units with a capacity less than 20 tons. Casing shall be fitted with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, structural support members, insulated condensate drip pan and drain, and internal insulation in the cold section of the casing. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness shall be 20 gauge. Provisions to permit replacement of major unit components shall be incorporated. Penetrations of cabinet surfaces, including the floor, shall be sealed. Unit shall be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan shall be fabricated from Type 300 stainless steel, galvanized steel with

protective coating as required, or an approved plastic material. Pan insulation shall be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces shall prevent, within limits of the specified insulation, heat transfer between the unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation shall conform to ASTM C 1071. Paint and finishes shall comply with the requirements specified in paragraph FACTORY COATING.

2.8.9.1 Indoor Cabinet

Indoor cabinets shall be suitable for the specified indoor service and enclose all unit components.

2.8.9.2 Outdoor Cabinet

Outdoor cabinets shall be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure. Cabinets constructed exclusively for indoor service which have been modified for outdoor service are not acceptable.

2.9 ACCESSORIES

2.9.8 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.9.9 Bolts and Nuts

Bolts and nuts shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

2.9.10 Bird Screen

Screen shall be 0.031 inch diameter stainless steel wire.

2.10 FINISHES

2.10.1 Factory Coating

2.10.1.1 Coil Corrosion Protection

Provide coil with a uniformly applied epoxy electrodeposition, phenolic, or vinyl type coating to all coil surface areas without material bridging between fins. Coating shall be applied at either the coil or coating manufacturer's factory. Coating process shall encure complete coil encapsulation. Coating shall be capable of withstanding a minimum 1,000 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution.

2.10.1.2 Equipment and Components

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 500 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride

solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.10.2 Factory Applied Insulation

Refrigeration equipment shall be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation shall be provided on the cold-gas inlet connection to the motor in accordance with manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

2.11 SUPPLEMENTAL COMPONENTS/SERVICES

2.11.2 Refrigerant Piping

Refrigerant piping for split-system unitary equipment shall be provided and installed in accordance with Section 23 23 00 REFRIGERANT PIPING.

2.11.4 Ductwork

Ductwork shall be provided and installed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.11.5 Temperature Controls

Temperature controls shall be in accordance with Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform Verification of Dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is specified to conform to the requirements of ASME BPVC SEC VIII D1and ASME BPVC SEC IX, the design, fabrication, and installation of the system shall conform to ASME BPVC SEC VIII D1 and

ASME BPVC SEC IX.

3.2.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ANSI/ASHRAE 15 & 34. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items. Compressors shall be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations shall be provided. Each foundation shall include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment shall be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps shall have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block shall be of mass not less than three times the combined pump, motor, and base weights. Isolators shall be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Lines connected to pumps mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.2.2 Mechanical Room Ventilation

Mechanical ventilation systems shall be in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.2.3 Field Applied Insulation

Field applied insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.3 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing shall be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

3.4 DEMONSTRATIONS

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 16 hours

of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

3.5 REFRIGERANT TESTS, CHARGING, AND START-UP

Split-system refrigerant piping systems shall be tested and charged as specified in Section 23 23 00 REFRIGERANT PIPING. Packaged refrigerant systems which are factory charged shall be checked for refrigerant and oil capacity to verify proper refrigerant levels in accordance with manufacturer's recommendations. Following charging, packaged systems shall be tested for leaks with a halide torch or an electronic leak detector.

3.5.1 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.5.2 Contractor's Responsibility

Take steps, at all times during the installation and testing of the refrigeration system, to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.6 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, conduct tests to demonstrate the general operating characteristics of all equipment by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Tests shall cover a period of not less than 48 hours for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Make corrections and adjustments, as necessary, tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit a report including the following information (where values are taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart):

a. Date and outside weather conditions.

b. The load on the system based on the following:

(1) The refrigerant used in the system.
(2) Condensing temperature and pressure.
(3) Suction temperature and pressure.
(4) Ambient, condensing and coolant temperatures.
(5) Running current, voltage and proper phase sequence for each phase of all motors.

c. The actual on-site setting of operating and safety controls.

d. Thermostatic expansion valve superheat - value as determined by field test.

e. Subcooling.

f. High and low refrigerant temperature switch set-points

g. Low oil pressure switch set-point.

h. Defrost system timer and thermostat set-points.

i. Moisture content.

j. Capacity control set-points.

k. Field data and adjustments which affect unit performance and energy consumption.

l. Field adjustments and settings which were not permanently marked as an integral part of a device.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
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.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM
Section 26 23 00 SWITCHBOARDS AND SWITCHGEAR
Section 26 51 00 INTERIOR LIGHTING

Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION

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 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 12.47 kV primary, three phase, four wire, 60and 480/277 volts secondary, three phase, four wire. Final connections to the power distribution system at the existing manhole and circuit breaker shall be made by the Contractor as directed by the Contracting Officer.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

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.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 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.

1.6.2 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 the technical section.

1.6.2.1 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.

1.6.2.2 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.

1.7 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 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.

1.9 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.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. 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.

1.11 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 IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, 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.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.13 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.

PART 2 PRODUCTS

2.1 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 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 the section specifying the associated electrical equipment.

3.2 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.

3.3 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.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 12 19.10

THREE-PHASE PAD-MOUNTED TRANSFORMERS
02/12

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.

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2014) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM D877/D877M	(2013) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D92	(2012b) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D97	(2012) Pour Point of Petroleum Products

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 386	(2006; INT 1 2011) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code
IEEE C37.47	(2011) Standard for High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
IEEE C57.12.00	(2010) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.34	(2009) Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.90	(2010) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.98	(2011) Guide for Transformer Impulse Tests
IEEE C62.11	(2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test

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 821-R-02-012	(2002) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

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

10 CFR 431	Energy Efficiency Program for Certain Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein. Section 26 27 14.00 20 ELECTRICITY METERING applies to this section.

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 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pad-mounted transformer drawings; G

SD-03 Product Data

Pad-mounted transformers; G

Submittal shall include manufacturer's information for each component, device, insulating fluid, and accessory provided with the transformer.

SD-06 Test Reports

Acceptance checks and tests; G

Submittal shall include acceptance criteria and limits for each test in accordance with NETA ATS "Test Values".

SD-07 Certificates

Transformer Efficiencies; G

Submit certification, including supporting calculations, from the manufacturer indicating conformance with the paragraph entitled "Specified Transformer Efficiencies."

SD-09 Manufacturer's Field Reports

Pad-mounted transformer design tests; G

Pad-mounted transformerroutine and other tests; G

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G

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; G

Submit report of test results as specified by paragraph entitled "Field Quality Control."

1.5 QUALITY ASSURANCE

1.5.1 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 .

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.

1.5.2 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.

1.5.3 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.

1.5.3.1 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 MAINTENANCE

1.6.1 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

g. Actual nameplate diagram

h. Date of purchase

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.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 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, feed-thru inserts, six high-voltage bushing wells configured for loop feed application, load-break switch handle(s), access to oil-immersed bayonet fuses, dead-front surge arresters, tap changer handle, connector parking stands with insulated standoff bushings, and ground pad.

a. Insulated high-voltage load-break connectors: IEEE 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 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

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 12,000 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.		LINE B SW		XFMR. SW	
		OPEN	CLOSE	OPEN	CLOSE	OPEN	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 Bonly	X			X		X
4	Transformer open and loop closed		X		X	X	
5	Transformer open and loop open	X		X		X	

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: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified. Connect current-limiting fuses ahead of the radial-feed load-break switch.

e. Surge arresters: IEEE C62.11, rated 8 kV, fully shielded, dead-front,

metal-oxide-varistor, elbow type with resistance-graded gap.. Provide three arresters for loop feed circuits.

f. Parking stands: Provide a parking stand near each bushing. Provide insulated standoff bushings for parking of energized high-voltage connectors on parking stands.

g. Protective caps: IEEE 386, 200 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushings.

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 300 kVA.

c. Transformer voltage ratings: 12470 V 480/277V.

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. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested percent impedance at 85 degrees C shall not be less than the following values:

2.50 for units rated 75kVA and below
2.87 for units rated 112.5kVA to 300kVA
4.03 for 500kVA rated units
5.32 for units rated 750kVA and above

f. 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

2000	61
2500	62

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 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 Efficiencies

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. No-load losses (NLL) shall be referenced at 20 degrees C. Load losses (LL) shall be referenced at 55 degrees C and at 50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in the "KVA / Efficiency" table below. That table is based on requirements contained within 10 CFR 431, Subpart K.

kVA	EFFICIENCY (percent)
15	98.36
30	98.62
45	98.76
75	98.91
112.5	99.01
150	99.08
225	99.17
300	99.23
500	99.25
750	99.32
1000	99.36
1500	99.42
2000	99.46
2500	99.49
above 2500	99.50

2.2.3 Insulating Liquid

a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877/D877M. 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 D97, less than -15 degree C

   2. Aquatic biodegradation: EPA 712-C-98-075, 100 percent

   3. Trout toxicity: OECD Test 203, zero mortality of EPA 821-R-02-012, pass

2.2.3.1 Liquid-Filled Transformer Nameplates

Distribution 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 A240/A240M, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad.

2.3 WARNING SIGNS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, 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.

2.4 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.5 PADLOCKS

Padlocks shall be provided for pad-mounted equipment . Padlocks shall be keyed as directed by the Contracting Officer.

2.6 SOURCE QUALITY CONTROL

2.6.1 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.

2.6.2 Design Tests

IEEE C57.12.00 states that "design tests are made only on representative apparatus to substantiate the ratings assigned to all other 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 the specified transformer. Design tests shall have been performed in accordance with IEEE C57.12.90 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 the primary windings only 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 IEEE C57.12.34.

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.

f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.

2.6.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests shall be performed in accordance with IEEE C57.12.90 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. Phase relation

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

Electrical installations shall conform to IEEE C2, NFPA 70, and to the 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

Reuse existing grounding electrode system. 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 ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 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.

3.3.1 Meters and Current Transformers

ANSI C12.1.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.5 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on existing concrete slab.

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 Sealing

When the installation is complete, the Contractor shall seal all entries into the equipment enclosure with an approved sealing method. 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 data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

3. Inspect anchorage, alignment, and grounding.

4. Verify the presence of PCB content labeling.

5. Verify the bushings and transformer interiors are clean.

6. 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.

7. Verify correct liquid level in tanks and bushings.

8. Verify that positive pressure is maintained on gas-blanketed transformers.

9. Perform specific inspections and mechanical tests as recommended by manufacturer.

10. Verify de-energized tap changer position is left as specified.

11. Verify the presence of transformer surge arresters.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

2. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

4. Perform turns-ratio tests at all tap positions.

5. Perform insulation power-factor or dissipation-factor tests on all windings in accordance with test equipment manufacturer's published data.

6. Perform power-factor or dissipation-factor tests on each bushing equipped with a power-factor/capacitance tap. In the absence of a power-factor/capacitance tap, perform hot-collar tests.

7. Measure the resistance of each high-voltage winding in each de-energized tap-changer position. Measure the resistance of each low-voltage winding in each de-energized tap-changer position, if applicable.

8. Remove and test a sample of insulating liquid for the following: Dielectric breakdown voltage, Acid neutralization number, Specific gravity, Interfacial tension, Color, Visual Condition, Water in insulating liquids (Required on 25 kV or higher voltages and on all silicone-filled units.), and Power factor or dissipation factor.

9. Perform dissolved-gas analysis (DGA) on a sample of insulating liquid.

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 wiring.

5. Verify the unit is clean.

6. 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.

7. Verify that all required grounding and shorting connections provide good contact.

8. Verify correct operation of transformer withdrawal mechanism and grounding operation.

9. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

2. Perform insulation-resistance test of each current transformer and its secondary wiring.

3. Perform a polarity test of each current transformer.

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 20 00

INTERIOR DISTRIBUTION SYSTEM
08/08

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.

ASTM INTERNATIONAL (ASTM)

ASTM B 1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	(2005) American National Standard for Electrical Metallic Tubing (EMT)
ANSI Z535.4	(2007) American National Standard for Product Safety Signs and Labels
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; Add/Errata 2000; Errata 2006; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2005) Terminal Blocks
NEMA ICS 6	(1993; R 2011) Enclosures

NEMA KS 1	(2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA MG 1	(2009) Motors and Generators
NEMA MG 10	(2001; R 2007) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1997; R 2001; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2013) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 1	(2009) Standard for Metal Cable Tray Systems
NEMA WD 1	(1999; R 2005) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2002; R 2008) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013;Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
NFPA 70E	(2015) Standard for Electrical Safety in the Workplace
NFPA 780	(2011) Standard for the Installation of Lightning Protection Systems

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

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2012) Standard for Flexible Metal Conduit
UL 1063	(2006) Machine-Tool Wires and Cables

UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1660	(2004; R thru 2008) Liquid-Tight Flexible Nonmetallic Conduit
UL 198M	(2003; R 2007) Standard for Mine-Duty Fuses
UL 20	(2010) General-Use Snap Switches
UL 360	(2013; Reprint May 2013) Liquid-Tight Flexible Steel Conduit
UL 4248	(2007) UL Standard for Safety Fuseholders
UL 44	(2010) Thermoset-Insulated Wires and Cables
UL 489	(2013; Reprint Mar 2014) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(2001; R 2001 - R 2010) Attachment Plugs and Receptacles
UL 50	(2007) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 506	(2008; R 2010) Specialty Transformers
UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment
UL 514B	(2012) Conduit, Tubing and Cable Fittings
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 651	(2011; Reprint May 2014) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel
UL 83	(2014) Thermoplastic-Insulated Wires and Cables
UL 870	(2008) Standard for Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	(2006; R 2008; R 2010) Ground-Fault Circuit-Interrupters

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in

IEEE 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Receptacles; G

Circuit breakers; G

Switches; G

Transformers; G

Enclosed circuit breakers; G

Motor controllers; G

Combination motor controllers; G

SD-06 Test Reports

600-volt wiring test; G

Grounding system test; G

SD-07 Certificates

Fuses; G

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23.00 25, OPERATION AND MAINTENANCE DATA and as specified herein.

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 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.

1.4.3 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.

1.4.3.2 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 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.

1.6 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

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

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40 in accordance with NEMA TC 2,UL 651.

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, ANSI 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

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steel compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.5 CABLE TRAYS

NEMA VE 1. Cable trays shall form a wireway system, and shall be of nominal depth as indicated. Cable trays shall be constructed of 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 as indicated.

2.5.3 Ladder-Type Cable Trays

Provide size as indicated with maximum rung spacing of 9 inches.

2.8 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.9 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.

2.9.1 Conductors

Conductors No. 10 AWG and larger diameter shall be stranded. Conductors No. 12 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 capacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.9.1.3 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.

2.9.2 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 neutrals shall be white with a different colored (not green) stripe for each. 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.

2.9.3 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, 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.

2.9.4 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.

2.10 SPLICES AND TERMINATION COMPONENTS

Splices are not permitted.

2.11 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.

2.12 SWITCHES

2.12.1 Toggle Switches

NEMA WD 1, UL 20, single pole, double pole, three-way, and four-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Handles shall be ivory thermoplastic. Wiring terminals shall be screw-type, side-wired or of the solderless pressure type having suitable conductor-release arrangement. 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.

2.12.3 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.12.4 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 per NEMA ICS 6.

2.13 FUSES

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.

2.13.1 Fuseholders

Provide in accordance with UL 4248.

2.13.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 198M, Class RK-1 RK-5 OR time-delay type. Associated fuseholders shall be Class R only.

2.14 RECEPTACLES

UL 498, hard use, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of ivory 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 or of the solderless pressure type having suitable conductor-release arrangement. Connect grounding pole to mounting strap. The receptacle shall contain triple-wipe power contacts and double or triple-wipe ground contacts.

2.14.2 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."

2.14.3 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 GFI devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.14.4 Special Purpose Receptacles

Provide in ratings indicated. Furnish one matching plug with each receptacle.

2.21 MOTORS

2.21.1 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. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.21.2 Premium Efficiency Polyphase Motors

Polyphase motors shall be selected based on high efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10. In addition, continuous rated, polyphase squirrel-cage medium induction motors shall meet the requirements for premium efficiency electric motors

in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.21.3 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. 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.

2.21.4 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. Power wiring and conduit shall conform to the requirements specified herein. Control wiring shall be provided under, and conform to the requirements of the section specifying the associated equipment.

2.22 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. 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. 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 22,000 rms symmetrical amperes. Provide controllers in hazardous locations with classifications as indicated.

2.22.1 Control Wiring

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.22.2 Control Circuit Terminal Blocks

NEMA ICS 4. Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement shall be subject to the approval of the Contracting Officer and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.22.2.1 Types of Terminal Blocks

a. Short-Circuiting Type: Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.22.3 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.

2.22.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.22.5 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.

2.22.6 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.

2.22.7 Pilot and Indicating Lights

Provide LED cluster lamps.

2.23 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single, Double, Three pole designed for surface mounting with overload protection and pilot lights.

2.23.1 Pilot Lights

Provide yoke-mounted, seven element LED cluster light module. Color shall be green red amber in accordance with NEMA ICS 2.

2.24 MOTOR CONTROL CENTERS

2.24.3 Combination Motor Controllers

UL 508 and other requirements in paragraph, MOTOR CONTROLLERS. Controller shall employ molded case circuit breaker fusible switch with clips for R -type fuses for branch circuit protection. Minimum short circuit withstand rating of combination motor controller shall be 20,000 rms symmetrical amperes. Circuit breakers for combination controllers shall be thermal magnetic magnetic only.

2.25 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.

2.28 GROUNDING AND BONDING EQUIPMENT

Reuse existing grounding and bonding system.

2.30 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.

2.31 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. 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.

2.32 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and ANSI Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. The marking shall be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.33 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations.

2.34 WIREWAYS

UL 870. Material shall be steel epoxy painted galvanized 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with screw- cover NEMA 1 enclosure per NEMA ICS 6.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of NFPA 70 and IEEE C2 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.

3.1.4 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

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. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped.

3.1.5.1 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.6 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches 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.

3.1.6.2 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.

g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.6.3 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.

(6) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.6.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.6.6 Service Entrance Conduit, Underground

PVC, Type-EPC 40. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.6.7 Underground Conduit Other Than Service Entrance

Convert nonmetallic conduit to steel conduit before rising through floor slab.

3.1.6.9 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.1.6.10 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.6.11 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.6.13 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 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.6.14 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 inches in reinforced concrete beams or to depth of more than 3/4 inch 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. 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 inches 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.

3.1.6.15 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.

3.1.6.16 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.

3.1.6.17 Flexible Connections

Provide flexible steel conduit ; 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 inch 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.

3.1.8 Cable Tray Installation

Install and ground in accordance with NFPA 70.. 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 foot intervals. 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 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Penetrations shall be firestopped. 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.

3.1.10 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 feet above floors and walkways. Boxes in other locations shall be sheet steel. 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 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. 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. 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 inches from box.

3.1.10.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet.

3.1.10.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge galvanized sheet steel, 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.

3.1.11 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor. Mount receptacles 18 inches above finished floor, unless otherwise indicated. Mount other devices as indicated.

3.1.14 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.

3.1.14.1 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.15 Splices

Splices are not permitted.

3.1.17 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 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.18 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings.

3.1.19 Grounding and Bonding

Provide In accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic

raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection at main service equipment. Interconnect all grounding media in or on the structure to provide a common ground potential.

3.1.19.1 Ground Rods

Reuse existing ground rods.

3.1.19.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, 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.

3.1.19.3 Ground Bus

Reuse the existing copper ground bus provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

3.1.19.4 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.

3.1.20 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.

3.1.23 Repair of Existing Work

Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

3.1.23.1 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.

3.1.23.2 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.

3.1.23.3 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, as indicated.

3.1.23.4 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.

3.1.25 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 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.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Where field painting of enclosures for panelboards, load centers or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each tests.

3.5.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.5.2 600-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.

3.5.4 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.

3.5.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. 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.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 23 00

SWITCHBOARDS AND SWITCHGEAR
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.

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D1535	(2013) Specifying Color by the Munsell System
ASTM D709	(2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code
IEEE C37.90.1	(2012) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA PB 2.1	(2013) General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 V or Less
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA LI 1	(1998; R 2011) Industrial Laminating Thermosetting Products
NEMA PB 2	(2011) Deadfront Distribution Switchboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment
UL 489	(2013; Reprint Mar 2014) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 891	(2005; Reprint Oct 2012) Switchboards

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

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchboard Drawings; G

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.

SD-03 Product Data

Switchboard; G

SD-06 Test Reports

Switchboard design tests; G

Switchboard production tests; G

Acceptance checks and tests; G

SD-10 Operation and Maintenance Data

Switchboard Operation and Maintenance, Data Package 5; G

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals; G

Equipment Test Schedule; G

Request for Settings; G

1.5 QUALITY ASSURANCE

1.5.1 Switchboard Product Data

Each submittal shall include manufacturer's information for each component, device and accessory provided with the switchboard including:

a. Circuit breaker type, interrupting rating, and trip devices, including available settings

b. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device.

1.5.2 Switchboard Drawings

Drawings shall include, but are not limited to the following:

a. One-line diagram including breakers

b. Outline drawings including front elevation, section views, footprint, and overall dimensions

c. Bus configuration including dimensions and ampere ratings of bus bars

d. Markings and NEMA nameplate data

e. Circuit breaker type, interrupting rating, and trip devices, including available settings

f. Three-line diagrams and elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.

g. Manufacturer's instruction manuals and published time-current curves (on full size logarithmic paper) of the main secondary breaker and largest secondary feeder device. These shall be used by the designer of record to provide breaker settings that will ensure protection and coordination are achieved.

1.5.3 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.

1.5.4 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.

1.5.4.1 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 manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 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 MAINTENANCE

1.6.1 Switchboard Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6.2 Assembled Operation and Maintenance Manuals

Manuals shall be assembled and bound securely in durable, hard covered, water resistant binders. The manuals shall be assembled and indexed in the following order with a table of contents. The contents of the assembled operation and maintenance manuals shall be as follows:

a. Manufacturer's O&M information required by the paragraph entitled "SD-10, Operation and Maintenance Data".

b. Catalog data required by the paragraph entitled, "SD-03, Product Data".

c. Drawings required by the paragraph entitled, "SD-02, Shop Drawings".

d. Prices for spare parts and supply list.

f. Design test reports

g. Production test reports

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.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be switchboards and related accessories are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SWITCHBOARD

NEMA PB 2 and UL 891.

2.2.1 Ratings

The voltage rating of the switchboard shall be 480Y/277 volts AC, 4-wire 3 phaseas indicated. The continuous current rating of the main bus shall be as indicated. The short-circuit current rating shall be as indicated. The switchboard shall be UL listed and labeled as service entrance equipment.

2.2.2 Construction

Switchboard shall consist of vertical sections bolted together to form a rigid assembly and shall be rear aligned. All circuit breakers shall be front accessible. Compartmentalized switchboards shall have vertical insulating barriers between the front device section, the main bus section,

and the cable compartment with full front to rear vertical insulating barriers between adjacent sections. Where indicated, "space for future" or "space" shall mean to include bus, device supports, and connections. Provide insulating barriers in accordance with NEMA LI 1, Type GPO-3, 0.25 inch minimum thickness. Apply moisture resistant coating to all rough-cut edges of barriers. Switchboard shall be completely factory engineered and assembled, including protective devices and equipment indicated with necessary interconnections, instrumentation, and control wiring.

2.2.2.1 Enclosure

The switchboard enclosure shall be a NEMA ICS 6 Type . Enclosure shall be bolted together with removable bolt-on side and rear covers. Bases, frames and channels of enclosure shall be corrosion resistant and shall be fabricated of. Base shall include any part of enclosure that is within 3 inches of concrete pad. Galvanized steel shall be ASTM A123/A123M, ASTM A653/A653M G90 coating, and ASTM A153/A153M, as applicable. Galvanize after fabrication where practicable. Paint enclosure, including bases, ASTM D1535 light gray No. 61 or No. 49. Paint coating system shall comply with IEEE C57.12.28 for galvanized steel and IEEE C57.12.29 for stainless steel.

2.2.2.2 Bus Bars

Bus bars shall be copper with silver-plated contact surfaces or aluminum with tin-plated contact surfaces. Plating shall be a minimum of 0.0002 inch thick. Make bus connections and joints with hardened steel bolts. The through-bus shall be rated at the full ampacity of the main throughout the switchboard. Provide minimum one-quarter by 2 inch copper ground bus secured to each vertical section along the entire length of the switchboard. The neutral bus shall be rated 100 percent of the main bus continuous current rating.

2.2.2.3 Main Section

The main section shall consist of main lugs only.

2.2.2.4 Distribution Sections

The distribution section shall consist ofindividually mounted, with current-limiting fusesmolded-case circuit breakers as indicated.

2.2.3 Protective Device

Provide branch protective devices as indicated.

2.2.3.1 Molded-Case Circuit Breaker

UL 489. UL listed and labeled, 100 percent rated, stationary,, manually operated, low voltage molded-case circuit breaker, with a short-circuit current rating of 22,000 rms symmetrical amperes at 480 volts. Breaker frame size shall be as indicated. Series rated circuit breakers are unacceptable.

2.2.4 Watthour and Digital Meters

2.2.4.1 Digital Meters

IEEE C37.90.1 for surge withstand. Provide true rms, plus/minus one

percent accuracy, programmable, microprocessor-based meter enclosed in sealed cases with a simultaneous three line, twelve value LED display. Meters shall have 0.56 inch, minimum, LEDs. Watthour meter shall have 0.56 inch, minimum, LEDs. The meters shall accept input from standard 5A secondary instrument transformers anddirect voltage monitoring range to 300 volts, phase to phase. Programming shall be via a front panel display and a communication interface with a computer. The meter shall calculate and store average max/min demand values for all readings based on a user selectable sliding window averaging period. The meter shall have programmable hi/low set limits with two Form C dry contact relays when exceeding alarm conditions. Historical trend logging capability shall include ability to store up to 100,000 data points with intervals of 1 second to 180 minutes. The unit shall also store and time stamp up to 100 programmable triggered conditions.

a. Multi-Function Meter: Meter shall simultaneously display a selected phase to neutral voltage, phase to phase voltage, percent phase to neutral voltage THD, percent phase to phase voltage THD; a selected phase current, neutral current, percent phase current THD, percent neutral current; selected total PF, kW, KVA, kVAR, FREQ, kVAh, kWh. Detected alarm conditions include over/under current, over/under voltage, over/under KVA, over/under frequency, over/under selected PF/kVAR, voltage phase reversal, voltage imbalance, reverse power, over percent THD. The meter shall have a Form C KYZ pulse output relay. Meter shall be able to communicate to BMS using IP/BACNET Protocol.

b. Power Meter: Meter shall simultaneously display Watts, VARs, and selected KVA/PF. Detected alarm conditions include over/under KVA, over/under PF, over/under VARs, over/under reverse power.

c. Volt Meter: Meter shall be selectable between simultaneous display of the three phases of phase to neutral voltages and simultaneous display of the three phases of the phase to phase voltages. Detected alarm conditions include over/under voltage, over/under voltage imbalance, over percent THD.

d. Ammeter: Meter shall simultaneously display phase A, B, and C currents. Detected alarm conditions include over/under current, over percent THD.

e. Digital Watthour Meter: Meter shall have a single selectable display for watts, total kilowatt hours (kWh) and watt demand (Wd). The meter shall have a Form C KYZ pulse output relay.

2.3 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. This nameplate and method of attachment may be the manufacturer's standard if it contains the required information.

2.4 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each switchboard, equipment enclosure, relay, switch, and device; as specified in this section 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.

2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules 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.

2.5.2 Switchboard Design Tests

NEMA PB 2 and UL 891.

2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

a. Short-circuit current test

b. Enclosure tests

c. Dielectric test

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

NFPA 70 and IEEE C2, except that grounds and 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 ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Equipment Grounding

Provide bare copper cable not smaller than No. 4/0 AWG not less than 24 inches below grade connecting to the indicated ground rods. When work in addition to that indicated or specified is directed 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 ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchboard

ANSI/NEMA PB 2.1.

3.3.2 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.3 Galvanizing Repair

Repair damage to galvanized coatings using ASTM A780/A780M, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.3.4 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.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Interior Location

Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 4 inches thick. The top of the concrete slab shall be approximately 4 inches above finished floor. Edges above floor 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 caulking 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.

3.5 FIELD QUALITY CONTROL

Contractor shall submit request for settings of breakers to the Contracting Officer after approval of switchboard and at least 30 days in advance of their requirement.

3.5.1 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.

3.5.1.1 Switchboard Assemblies

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical, electrical, and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Verify appropriate anchorage, required area clearances, and correct alignment.

5. Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

6. Verify that circuit breaker sizes and types correspond to approved shop drawings.

7. Verify that current transformer ratios correspond to approved shop drawings.

8. 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.

9. Confirm correct operation and sequencing of electrical and mechanical interlock systems.

10. Clean switchboard.

11. Inspect insulators for evidence of physical damage or contaminated surfaces.

13. Exercise all active components.

14. Inspect all mechanical indicating devices for correct operation.

15. Verify that vents are clear.

16. Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.

17. Inspect control power transformers.

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. 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 all required grounding and shorting connections provide good contact.

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 and voltage transformer secondary circuits are intact.

3.5.1.4 Grounding System

a. Visual and Mechanical Inspection

1. Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

1. IEEE 81. 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.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, 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. Circuit breakers shall be tripped by operation of each protective device. Test shall require each item to perform its function not less than three times. 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 for checks, settings, and tests.

-- End of Section --

SECTION 26 27 14.00 20

ELECTRICITY METERING
02/11

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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code
IEEE C37.90.1	(2012) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C57.13	(2008; INT 2009) Standard Requirements for Instrument Transformers
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60687	(1992) Alternating Current Static Watt-Hour Meters for Active Energy (Classes 0,2 S and 0,5 S)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
ANSI C12.18	(2006) Protocol Specification for ANSI Type 2 Optical Port
ANSI C12.20	(2010) Electricity Meters - 0.2 and 0.5 Accuracy Classes
ANSI C12.7	(2014) Requirements for Watthour Meter Sockets
NEMA C12.19	(2008) Utility Industry End Device Data Tables

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Electricity meters; G

Current transformer; G

Potential transformer; G

External communications devices; G

SD-06 Test Reports

Acceptance checks and tests; G

System functional verification; G

Completed meter data schedule; G

Meter configuration template; G

Contractor shall fill in the meter configuration template and submit to the Activity for concurrence.

Meter configuration report; G

SD-10 Operation and Maintenance Data

Electricity Meters and Accessories, Data Package 5; G

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

System functional verification; G

1.4 QUALITY ASSURANCE

1.4.1 Installation Drawings

Drawings shall be provided in hard-copy and electronic format, and shall include but not be limited to the following:

a. Wiring diagrams with terminals identified of kilowatt meter, current transformers, and communications interfaces.

1.4.2 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 1 year prior to bid opening. The 1-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product, or an earlier release of the product, shall have been on sale on the commercial market through advertisements, manufacturers catalogs, or brochures during the prior 1-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.

1.4.3 Material and Equipment Manufacturing Data

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

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 electricity meters and accessories provided:

a. A condensed description of how the system operates

b. Block diagram indicating major assemblies

c. Troubleshooting information

d. Preventive maintenance

e. Prices for spare parts and supply list

1.6 WARRANTY

The equipment items and software shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment and software on a regular and emergency basis during the warranty period of the contract.

1.7 SYSTEM DESCRIPTION

1.7.1 System Requirements

Electricity metering, consisting of meters and associated equipment, will be used to record the electricity consumption and other values as described in the requirements that follow. Communication system requirements are contained in a separate specification section as identified in paragraph entitled "Communications Interfaces".

1.7.2 Selection Criteria

Metering components and software are part of a system that includes the physical meter, data recorder function and communications method. Every building site identified shall include sufficient metering components to measure the electrical parameters identified and to store and communicate the values as required.

Contractor shall verify that the metering system installed on any building site is compatible with the facility-wide or base-wide communication and meter reading protocol system.

PART 2 PRODUCTS

2.1 ELECTRICITY METERS AND ACCESSORIES

2.1.1 Physical and Common Requirements

a. Provide metering system components in accordance with the Metering System Schedule shown in this specification. Provide Meter configuration template.

b. Existing meter bases can be re-used if they are electrically functional, in physically good condition, and show no signs of corrosion on the electrical contacts. If the existing meter base is usable, the meter base determines meter form factor. If a new meter is being installed, use meter and base form factor of 9S unless installation-specific limitations require the use of a different form type.

c. Meter shall have NEMA 3R stainless steel enclosure for surface mounting with bottom or rear penetrations.

d. Surge withstand capability shall conform to IEEE C37.90.1.

e. Use #12 SIS (XHHW, or equivalent) wiring with ring lugs for all meter connections. Color code and mark the conductors as follows:

(1) Red - Phase A CT - C1
(2) Orange - Phase B CT - C2
(3) Brown - Phase C CT - C3
(4) Gray with white stripe - neutral current return - C0
(5) Black - Phase A voltage - V1
(6) Yellow - Phase B voltage - V2
(7) Blue - Phase C voltage - V3
(8) White - Neutral voltage

2.1.2 Potential Transformer Requirements

a. Meter shall be capable of connection to the service voltage phases and magnitude being monitored. If the meter is not rated for the service voltage, provide suitable potential transformers to send an acceptable voltage to the meter.

b. Voltage input shall be optically isolated to 2500 volts DC from signal and communications outputs. Components shall meet or exceed IEEE C37.90.1.

c. Provide one fuse per phase, Class RK type, to protect the voltage input to the meter. Size fuses as recommended by the meter manufacturer. Fusing shall either be inside the secondary compartment of the transformer or inside the same enclosure as the CT shorting device.

d. Potential transformers will be used to convert 480 volt inputs to 120 volts as required. Potential transformers shall be rated indoor or outdoor, as required for the specific application. Voltage rating shall provide 120 volts, wye-connected, 3 phase, 4 wire, 60 Hz, insulation class, 600 volts. Potential transformers BIL shall be 10 kV and shall have an accuracy class of 0.3 at burdens w, x, and y. Thermal rating shall be 500 VA.

2.1.3 Current Transformer Requirements

a. Current transformer shall be installed with a rating as shown in the schedule.

b. Current transformers shall have an Accuracy Class of 0.3 (with a maximum error of plus/minus 0.3 percent at 5.0 amperes) when operating within the specified rating factor.

c. Current transformers shall be solid-core, bracket-mounted for new installations using ring-tongue lugs for electrical connections. Current transformers shall be accessible and the associated wiring shall be installed in an organized and neat workmanship arrangement.

d. Current transformers shall have:

(1) Insulation Class: All 600 volt and below current transformers shall be rated 10 KV BIL.

(2) Frequency: Nominal 60 Hz.

(3) Burden: Burden class shall be selected for the load.

(4) Phase Angle Range: 0 to 60 degrees.

e. Meter shall accept current input from standard instrument transformers (5A secondary current transformers).

f. Current inputs shall have a continuous rating in accordance with IEEE C57.13.

g. Provide one single-ratio current transformer for each phase per power transformer with characteristics listed in the following table.

Single-Ratio Current Transformer Characteristics				
kVA	Sec. Volt	CT Ratio	RF	Meter Acc. Class
300	480/277	400/5	1.33	0.3 thru B0.05

2.1.4 Meter Requirements

a. Meter shall comply with ANSI C12.1, NEMA C12.19, and ANSI C12.20.

b. Meter sockets shall comply with ANSI C12.7.

c. Meter shall comply with IEC 60687 certified by a qualified 3rd party test laboratory.

d. Provide socket-mounted or panel mounted meters as required.

e. Meter shall be a Class 20, transformer rated design.

f. Meter shall be rated for use at temperature from minus 40 degrees Centigrade to plus 70 degrees Centigrade.

g. The meters shall have an electronic demand recording register and shall be secondary reading as indicated. The register shall be used to indicate maximum kilowatt demand as well as cumulative or continuously cumulative demand. Demand shall be measured on a block-interval basis and shall be capable of a 5 to 60 minute interval and initially set to a 15-minute interval. It shall have provisions to be programmed to calculate demand on a rolling interval basis. Meter readings shall be true RMS.

h. The meter electronic register shall be of modular design with non-volatile data storage. Downloading meter stored data shall be capable via an optical port. Recording capability of data storage with a minimum capability of 89 days of 15 minute, 2 channel interval data. The meter shall be capable of providing at least 2 KYZ pulse outputs (dry contacts). Default initial configuration (unless identified otherwise by base personnel) shall be:

(1) First channel - kWh
(2) Second channel - kVARh
(3) KYZ output #1 - kWh
(4) KYZ output #2 - kVARh

i. Enable switches for Time of Use (TOU), pulse and load profile measurement module at the factory.

j. Meter shall have an optical port on front of meter capable of speeds from 9600 to a minimum of 19.2k baud, and shall be initially set at 9600 baud. Optical device shall be compatible with ANSI C12.18.

k. Meters shall be 120-480 volts auto ranging.

l. Provide blank tag fixed to the meter faceplate for the addition of the meter multiplier, which will be the product of the current transformer ratio and will be filled in by base personnel on the job site. The meter's nameplate shall include:

(1) Meter ID number.
(2) Rated voltage.
(3) Current class.
(4) Metering form.
(5) Test amperes.
(6) Frequency.
(7) Catalog number.
(8) Manufacturing date.

m. Meter covers shall be polycarbonate resins with an optical port and reset. Backup battery shall be easily accessible for change-out after removing the meter cover.

n. The normal billing data scroll shall be fully programmable. Data scroll display shall include the following.

(1) Number of demand resets.
(2) End-of-interval indication.
(3) Maximum demand.
(4) New maximum demand indication.
(5) Cumulative or continuously cumulative.
(6) Time remaining in interval.
(7) Kilowatt hours.

o. The register shall incorporate a built-in test mode that allows it to be tested without the loss of any data or parameters. The following quantities shall be available for display in the test mode:

(1) Present interval's accumulating demand.
(2) Maximum demand.
(3) Number of impulses being received by the register.

p. Pulse module simple I/O board with programmable ratio selection.

q. Meters shall be programmed after installation via an optical port. Optical display shall show TOU data, peak kWh, semi-peak kWh, off peak kWh, and phase angles.

r. Self-monitoring to provide for:

(1) Unprogrammed register.
(2) RAM checksum error.
(3) ROM checksum error.
(4) Hardware failure.
(5) Memory failure.
(6) EPROM error.
(7) Battery status (fault, condition, or time in service).

s. Liquid crystal alphanumeric displays, 9 digits, blinking squares confirm register operation. 6 Large digits for data and smaller digits for display identifier.

t. Display operations, programmable sequence with display identifiers. Display identifiers shall be selectable for each item. Continually sequence with time selectable for each item.

u. The meters shall support three modes of registers: Normal Mode, Alternate Mode, and Test Mode. The meter also shall support a "Toolbox" or "Service Information" (accessible in the field) through an

optocom port to a separate computer using the supplied software to allow access to instantaneous service information such as voltage, current, power factor, load demand, and the phase angle for individual phases.

v. Meter shall have a standard 4-year warranty.

2.1.5 Disconnect Method

a. Provide a 10-pole safety disconnect complete with isolation devices for the voltage and current transformer inputs, including a shorting means for the current transformers.

b. Voltage monitoring circuits shall be equipped with disconnect switches to isolate the meter base or socket from the voltage source.

2.1.6 Installation Methods

a. Stand Mounted Adjacent to Transformer ("STAND" in Metering Systems Schedule). Meter base shall be mounted on a structural steel pole approximately 4 feet from the transformer pad.

2.2 COMMUNICATIONS INTERFACES

Meter shall have two-way communication with the existing data acquisition system (DAS). Provide a communications interface utilizing IP/BACNET Protocol.

Provide interfacing software if a meter is used that is different than the existing meters at the Activity to ensure compatibility within the metering system.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70 (National Electrical Code), and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.1.1 Existing Condition Survey

The Contractor shall perform a field survey, including inspection of all existing equipment, resulting clearances, and new equipment locations intended to be incorporated into the system and furnish an existing conditions report to the Government. The report shall identify those items that are non-workable as defined in the contract documents. The Contractor shall be held responsible for repairs and modifications necessary to make the system perform as required.

3.1.1.1 Existing Meter Sockets

In some cases, the existing meter sockets will have to be replaced to accommodate the new electrical meters. An existing socket is considered unacceptable for any of the following conditions:

a. It is a non-ANSI form factor meter socket.

b. It is weathered beyond the point of being safe to reuse.

c. It is installed incorrectly, such as a non-weather resistant enclosure installed outdoors.

d. It is not the correct form factor for the existing electrical service.

3.1.1.2 Existing Installations

As part of the existing condition survey, the following applies for installations with existing meters:

a. Replace any meters that do not comply with this section.

b. If CTs are installed, verify that they comply with this section. If they do not comply, replace them with CTs that comply with this section. One CT per phase is required for wye-connected systems.

c. If potential transformers are installed on low-voltage systems, remove the PTs as part of the installation.

d. Install disconnect switches as specified in this section.

3.1.2 Scheduling of Work and Outages

The Contract Clauses shall govern regarding permission for power outages, scheduling of work, coordination with Government personnel, and special working conditions.

3.1.3 Configuration Software

The standard meter shall include the latest available version of firmware and software. Meter shall either be programmed at the factory or shall be programmed in the field. Meters shall have a password that shall be provided to the contracting officer upon project completion. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. When interfacing software is used for a meter that is different than the existing meters in use at the Activity, turn the software over to the Contracting Officer at completion of the project.

3.2 FIELD QUALITY CONTROL

Perform the following acceptance checks and tests on installed meters.

3.2.1 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.

a. Meter Assembly

(1) Visual and mechanical inspection.

(a) Compare equipment nameplate data with specifications and approved shop drawings.

(b) Inspect physical and mechanical condition. Confirm the meter is firmly seated in the socket, the socket is not abnormally

heated, the display is visible, and the ring and seal on the cover are intact.

(c) Inspect all electrical connections to ensure they are tight. For Class 200 services, verify tightness of the service conductor terminations for high resistance using low-resistance ohmmeter, or by verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(d) Record model number, serial number, firmware revision, software revision, and rated control voltage.

(e) Verify operation of display and indicating devices.

(f) Record password and user log-in for each meter.

(g) Verify grounding of metering enclosure.

(h) Set all required parameters including instrument transformer ratios, system type, frequency, power demand methods/intervals, and communications requirements. Verify that the CT ratio and the PT ratio are properly included in the meter multiplier or the programming of the meter. Confirm that the multiplier is provided on the meter face or on the meter.

(i) Provide building meter installation sheet, per building for each facility. See example Graphic E-S1.

(j) Provide the completed meter installation schedule for the installation. See example Graphic E-S2

(k) Provide the completed meter data schedule for the installation. See example Graphic E-S3.

(2) Electrical tests.

(a) Apply voltage or current as appropriate to each analog input and verify correct measurement and indication.

(b) Confirm correct operation and setting of each auxiliary input/output feature including mechanical relay, digital, and analog.

(c) After initial system energization, confirm measurements and indications are consistent with loads present.

(d) Make note of, and report, any "Error-Code" or "Caution-Code" on the meter's display.

(3) Provide meter configuration report.

b. Current Transformers

(1) Visual and mechanical inspection.

(a) Compare equipment nameplate data with specification and approved shop drawings.

(b) Inspect physical and mechanical condition.

(c) Verify correct connection, including polarity.

(d) Inspect all electrical connections to ensure they are tight.

(e) Verify that required grounding and shorting connections provide good contact.

(2) Electrical Tests.

Verify proper operation by reviewing the meter configuration report.

3.2.2 System Functional Verification

Verify that the installed meters are working correctly in accordance with the meter configuration report:

a. The correct meter form is installed.

b. All voltage phases are present.

c. Phase rotation is correct.

d. Phase angles are correct.

e. The new meter accurately measures power magnitude and direction, and can communicate as required by paragraph entitled "Communications Interfaces".

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 36 23.00 20

AUTOMATIC TRANSFER SWITCHES
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	(2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008	(2012; Reprint Apr 2013) Transfer Switch Equipment
UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 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

Government approval is required for submittals with a "G" designation submittals not having a "G" designation are approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Automatic Transfer Switch Drawings; G

SD-03 Product Data

Automatic Transfer Switches; G

SD-06 Test Reports

Acceptance Checks and Tests; G

Functional Acceptance Tests; G

SD-07 Certificates

Proof of Listing; G

SD-10 Operation and Maintenance Data

Automatic Transfer Switches, Data Package 5; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Proof of Listing

Submit proof of listing by UL 1008.

1.4.2 Automatic Transfer Switch Drawings

Drawings shall include outline, arrangement, and detail drawings. Detail drawings shall include manufacturer's name and catalog number, electrical ratings, total system transfer statement, reduced normal supply voltage at which transfer to the alternate supply is initiated, transfer delay times, short-circuit current rating, wiring diagram, description of interconnections, testing instructions, acceptable conductor type for terminals, tightening torque for each wire connector, and other required UL 1008 markings.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

Provide four-pole, automatic transfer switches for use in emergency systems in accordance with UL 1008. Each automatic transfer switch shall be rated for total system transfer and have the current and voltage ratings as indicated. The rating of the switch shall be adequate for withstanding the effects of the indicated RMS symmetrical fault current when protected by the indicated overcurrent device without contact welding. The switch operating mechanism shall be electrically operated from the source to which it is transferring, shall have quick-make, quick-break, load break contacts, and shall be mechanically held in both positions. Non-fire pump service transfer switches shall have manual operating means provided for maintenance and servicing accessible only by opening the enclosure. The manual operating means shall affect the opening and closing of the switch contacts at the same rate of speed as that caused by the automatic operation of the switch. Automatic transfer switch shall be equipped with by-pass/isolation switch mounted on a drawout mechanism so that the automatic transfer switch can be removed from the enclosure. The switch enclosure shall comply with UL 508, NEMA Type 1,, and shall be equipped with an equipment ground lug.

2.1.1 By-Pass/Isolation Switches

Include by-pass/isolation switches for the indicated automatic transfer switches. Provide by-pass/isolation switches in accordance with UL 1008 that can be used to manually select an available power source to feed load circuits and to permit total isolation of the automatic transfer switch.

The by-pass/isolation switch shall be rated for total system transfer and have the same current rating, voltage rating, number of poles, and withstand and closing rating as the associated automatic transfer switch.

2.1.2 Automatic Transfer Switch Controls

2.1.2.1 Controls for Fire Pump Service Automatic Transfer Switch

Provide the following additional controls features:

a. Phase reversal of the normal source shall initiate transfer to the emergency/alternate source.

2.1.3 Front Panel Devices

Provide devices mounted on cabinet front consisting of:

a. Mode selector switch with the following positions and associated functions;

   1. TEST - Simulates loss of normal/preferred source system operation.

   2. NORMAL - Transfers system to normal/preferred source bypassing re-transfer time delay.

b. Lamps for indicating connected source and normal/preferred source is available.

c. Auxiliary contacts for indicating connected source and normal/preferred source available.

e. Lamps for indicating that the by-pass/isolation switch is in the "normal by-pass", "alternate by-pass", or "isolated" position.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements of NFPA 70 and manufacturer's recommendation.

3.2 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the automatic transfer switch.

3.2.1 Performance of Acceptance Checks and tests

Complete as specified in paragraph entitled "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.

3.2.2 Manufacturers O&M Information

The manufacturers O&M information required by the paragraph entitled "SD-10 Operation and Maintenance Data", shall have been submitted to and approved by the Contracting Officer.

3.2.3 Test Equipment

All test equipment and instruments shall be on hand prior to scheduling field tests, or subject to Contracting Officer's 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.

3.3 FIELD QUALITY CONTROL

Give Contracting Officer 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, apparatus, including test load, and consumables required for the specified tests. Calibration of all measuring devices and indicating devices shall be certified. The test load shall be a cataloged product in accordance with Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS. Perform the following field tests in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.3.1 Automatic Transfer Switch Acceptance Checks and Tests

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Verify that manual transfer warnings are attached and visible.

5. Verify tightness of all control connections.

6. Verify tightness of accessible bolted connections by calibrated torque-wrench method. Thermographic survey is not required.

7. Perform manual transfer operation.

8. Verify positive mechanical interlocking between normal and alternate sources.

b. Electrical Tests

1. Measure contact-resistance.

2. Perform insulation-resistance on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole for one minute. Perform tests in both source positions.

3. Verify settings and operations of control devices.

4. Calibrate and set all relays and timers.

3.3.2 Functional Acceptance Tests

Functional Acceptance Tests shall include simulating power failure and demonstrating the following operations for each automatic transfer switch. Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition, and function not less than five times.

a. Perform automatic transfer tests:

1. Simulate loss of normal/preferred power.

2. Return to normal/preferred power.

3. Simulate loss of emergency power.

4. Simulate all forms of single-phase conditions.

b. Verify correct operation and timing of the following functions:

1. Normal source voltage-sensing relays.

2. Engine start sequence.

3. Time delay upon transfer.

4. Alternate source voltage-sensing relays.

5. Automatic transfer operation.

6. Interlocks and limit switch function.

7. Time delay and retransfer upon normal power restoration.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 51 00

INTERIOR LIGHTING
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.

CALIFORNIA ENERGY COMMISSION (CEC)

CEC Title 24	(2008; Effective Jan 2010) California's Energy Efficiency Standards for Residential and Nonresidential Buildings

ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10	(2011) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI ANSLG C78.42	(2009) For Electric Lamps: High-Pressure Sodium Lamps
ANSI C78.1381	(1998) American National Standard for Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps
ANSI C78.901	(2005) American National Standard for Electric Lamps - Single Base Fluorescent Lamps--Dimensional and Electrical Characteristics
ANSI C82.4	(2002) American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.81	(2013) American National Standard for Electric Lamps--Double-Capped Fluorescent Lamps--Dimensional and Electrical Characteristics
NEMA ANSLG C82.11	(2011) Lamp Ballasts - High-Frequency Fluorescent Lamp Ballasts
NEMA LL 1	(1997; R 2002) Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP Extraction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2015) Life Safety Code
NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

UNDERWRITERS LABORATORIES (UL)

UL 1029	(1994; Reprint Dec 2013) High-Intensity-Discharge Lamp Ballasts
UL 1598	(2008; Reprint Oct 2012) Luminaires
UL 773	(1995; Reprint Mar 2002) Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	(2006; Reprint Nov 2013) Standard for Nonindustrial Photoelectric Switches for Lighting Control
UL 924	(2006; Reprint Apr 2014) Standard for Emergency Lighting and Power Equipment
UL 935	(2001; Reprint Aug 2014) Standard for Fluorescent-Lamp Ballasts

1.2 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

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 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SYSTEM DESCRIPTION

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. 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:

Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by theIES HB-10 , as applicable, for the lighting system specified.

SD-03 Product Data

Fluorescent lighting fixtures; G

Fluorescent electronic ballasts; G

Fluorescent lamps; G

High-intensity-discharge (HID) lighting fixtures; G

HID ballasts; G

High-pressure sodium (HPS) lamps; G

Low-pressure sodium lamps; G

Metal-halide lamps; G

Photocell switch; G

Exit signs; G

Emergency lighting equipment; G

Occupancy sensors; G

1.6 QUALITY ASSURANCE

1.6.1 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.

1.6.2 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.

1.6.3 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.

1.6.3.1 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.

1.6.3.2 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.

1.6.3.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. 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.

1.7.1 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 .

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 ANSLG C82.11, NFPA 70, and CEC Title 24 unless specified otherwise. Ballast shall be 100 percent electronic high frequency type with no magnetic core and coil components. Ballast shall provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. 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 factor shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

f. Ballast shall be UL listed Class P with a sound rating of "A."

g. Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

h. Ballasts shall be instant start unless otherwise 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.

i. Ballasts for compact fluorescent fixtures shall be programmed start.

j. Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by NEMA ANSLG C78.81 and ANSI C78.901 as applicable.

k. Ballast shall be capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

l. 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. Ballast efficacy factor.

1. 2.54 (minimum) when operating one F32T8 lamp

2. 1.44 (minimum) when operating two F32T8 lamps

3. 0.93 (minimum) when operating three F32T8 lamps

4. 0.73 (minimum) when operating four F32T8 lamps

.

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 ANSLG C82.11, UL 935, and NFPA 70, unless specified otherwise. Ballast shall provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. 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.

2.1.3 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.

2.1.4 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

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 ANSI C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type (minimum 90 percent). 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

ANSI ANSLG C78.42 wattage as indicated. 150 watt lamps, if required, shall be 55 volt type.

2.2.3 Metal-Halide Lamps

a. Double-ended, 70 watt, conforming to ANSI C78.1381

2.2.3.1 Luminaire Efficiency Rating (LER)

a. Upward efficiency of 0 percent

1. 150-399 watts: minimum 41 LER for closed fixture

b. Upward efficiency of 1 percent - 10 percent

1. 150-399 watts: minimum 56 LER for closed fixture

2.3 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 allow fixtures to swing within an angle of 45 degrees. Single-unit suspended fixtures shall have twin-stem hangers. Multiple-unit or continuous row 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.

2.4 SWITCHES

2.4.1 Toggle Switches

Provide toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.5 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 277 volts ac, 60 Hz with single-throw contacts 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:

2.6 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered type. Exit signs shall use no more than 5 watts.

2.6.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, test switch, pilot light, 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).

2.7 EQUIPMENT IDENTIFICATION

2.7.1 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.

2.7.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. All

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.

All 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.

2.8 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 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 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 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 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 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.

3.2 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.

3.3 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.

3.3.1 Electronic Dimming Ballast

Test for full range of dimming capability. Observe for visually detectable

flicker over full dimming range.

3.3.2 Occupancy Sensor

Test sensors for proper operation. Observe for light control over entire area being covered.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 31 00 00

EARTHWORK
08/08

PART 1 GENERAL

1.1 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

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

1.3 DEFINITIONS

1.3.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D2487 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.

1.3.2 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.

1.3.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 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 D4318, ASTM C136, ASTM D422, and ASTM D1140.

1.5.4 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 D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 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.

1.5.7 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated

deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 3 inch in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.5.8 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.5.9 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.5.11 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 3 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 2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.5.12 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 5 when tested in accordance with ASTM D4318.

1.6 SYSTEM DESCRIPTION

1.6.2 Blasting

Blasting will not be permitted.

1.6.3 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering Work Plan; G

SD-03 Product Data

SD-06 Test Reports

Testing
Borrow Site Testing

SD-07 Certificates

Testing

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. Within 24 hours of conclusion of physical tests, submit 2 copies of test results, including calibration curves and results of calibration tests. Do not bring material onsite until tests have been approved by the Contracting Officer.

PART 3 EXECUTION

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 other approved areas selected by the Contractor as specified.

3.1.1 Contractor

Contactor shall be responsible for repair of utilities damaged at no cost to the government.

3.2.1 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.

3.2.2 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.3 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 and 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.

3.3.1 Final Backfill

Where applicable, place backfill material and compact as follows:

a. Turfed or Seeded Areas and Miscellaneous Areas: Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.4 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface as directed by the Contracting Officer. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated on the drawings. 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.

3.4.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times.

3.6 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. 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.

a. Determine field in-place density in accordance with ASTM D6938. When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556. ASTM D6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.

b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; 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.

c. 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.

3.6.1 Fill and Backfill Material Gradation

One test per 500 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C136.

3.6.2 In-Place Densities

a. One test per 2500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 1500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 250 linear feet, or fraction thereof, of each lift of embankment or backfill for airfields.

3.6.3 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.

3.6.4 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.7 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 removed from Government property as directed by the Contracting Officer.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 31 10 00

CLEARING
08/08

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Clearing (Timber and Structure)

1.1.1.1 Payment

Payment will be made for costs associated with furnishing plant, labor, materials and equipments, and performing all operations necessary for clearing (timber and structures) as specified.

1.1.1.2 Unit of Measure

Unit of measure: lump sum.

DEFINITIONS

1.2 Trees

The line of demarcation between brush and trees, for the purpose of distinguishing clearing requirements, is that trees, as used, will be considered as that woody growth not falling within the limits of brush as defined below.

1.3 Brush

Brush is that growth which is less than 2 inches in diameter measured6 inches from the ground on the uphill side and is less than 6 feet in height measured from the ground on the uphill side.

1.4 Structures

The term "structures" includes asphalt cement concrete, concrete pads, lights, etc. Structures shall be removed.

1.4.1 Construction Roads

All construction roads proposed for use by the Contractor for access to the work area shall be approved, as to location and alignment, prior to construction. Where such roads are determined to be of no value to project operation or will not serve recreational access needs after project construction, the areas occupied by these roads will be restored as nearly as possible to pre-construction conditions by reasonable grading and seedi ng.

1.5 Existing Conditions

1.5.1 Structures

Completely remove all structures including base and subbase and dispose off site. Any unsuitable material encountered during removal shall also be

removed and disposed of off site. Replace area with suitable material to the elevations shown on the drawings. All material to be disposed of off site shall become property of the Contractor. All areas disturbed shall be completely filled to the ground surface elevations shown on the drawings with earth, borrowed as directed by the Contracting Officer. The top surfaces of fills shall be neat in appearance and smooth.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

2.1 General

The material cleared from the areas shall be completely removed by transporting from the Government property unless otherwise approved by the Contracting Officer.

2.2 Removal from Site

Except as otherwise provided, the Contractor will be permitted to remove all material cleared from the site of the work.

2.3 MARKETABLE MATERIALS

Any of the cleared materials which the Contractor considers marketable shall become its property and shall be removed from the construction area.

2.4 LOCATIONS

The locations of structures to be cleared are shown on the drawings.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL
02/11

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 WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM D1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	(2012) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

1.2 DEFINITIONS

1.2.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or

gravel having a high porosity which is 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 a slab.

1.2.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698, for general soil types, abbreviated as percent laboratory maximum density.

1.2.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.4 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering work plan

SD-06 Test Reports

Fill and backfill test

Porous fill test for capillary water barrier

Density tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

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. Suitable backfill and bedding material in the quantities required is not available at the project site.

d. Blasting will not be permitted. Remove material in an approved manner.

1.6 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for TPH, BTEX, and full TCLP including ignitability, corrosively and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCLP test. TPH concentrations shall be determined by using EPA 600/4-79/020 EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 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 results have been received and approved by the Contracting Officer.

1.7 QUALITY ASSURANCE

1.7.1 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.7.2 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. 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.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Backfill and Fill Material

ASTM D2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum

ASTM D4318 liquid limit of 35, maximum ASTM D4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D1140, No. 200 sieve.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C33/C33M fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve, or 1-1/2 inches and no more than 2 percent by weight passing the No. 4 size sieve or coarse aggregate Size 57, 67, or 77 and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

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. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, 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 inches, 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 D2487.

2.3.1 Sand

Clean, coarse-grained sand classified as in accordance with ASTM D2487 for bedding and backfill.

2.3.2 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof in accordance with Texas State Standard or having a classification of GW GP in accordance with ASTM D2487 for bedding and backfill. Maximum particle size shall not exceed 1/4 inches.

2.4 BURIED WARNING AND IDENTIFICATION TAPE

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. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes	
Red:	Electric

Warning Tape Color Codes	
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Potable Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air
Purple:	Non Potable, Reclaimed Water, Irrigation and Slurry lines

2.4.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.4.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured 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.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.1.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/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, prevent erosion and undermining of foundations. 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. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.1.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted 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. Control measures shall be taken 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, the water level shall be maintained continuously, at least 1 feet below the working level.

Operate dewatering system continuously until construction work below existing water levels is complete. Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.

3.1.2 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact the owner for assistance in locating existing utilities. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered. The Contractor shall contact NVECES Electric Cooperative 361-387-2581 to detect existing electric utilities.

3.1.3 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove items that would interfere with construction operations within lines 5 feet outside of each utility line.

3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable

for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with porous fill and compact to 95 percent of ASTM D698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with porous fill and compact to 95 percent of ASTM D698 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.2 Hard Material and Rock Excavation

Remove hard material and rock to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material and rock beyond lines and grades indicated will not be grounds for a claim for additional payment unless previously authorized by the Contracting Officer. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer. Common excavation shall consist of all excavation not classified as rock excavation.

3.3.3 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.4 FILLING AND BACKFILLING

3.4.1 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.4.2 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.4.3 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.5 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.6 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.7 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.7.1 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D698. Compact fill and backfill materials to 95 percent of ASTM D698.

3.8 FINISH OPERATIONS

3.8.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.8.2 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.9 DISPOSITION OF SURPLUS MATERIAL

Any surplus material shall be disposed of as directed by the Contracting Officer.

3.10 FIELD QUALITY CONTROL

3.10.1 Sampling

Take the number and size of samples required to perform the following tests.

3.10.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.10.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 for moisture density relations, as applicable.

3.10.2.2 Select Material Testing

Test select material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 for moisture density relations, as applicable.

3.10.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C136 for conformance to gradation specified in ASTM C33/C33M.

3.10.2.4 Density Tests

Test density in accordance with ASTM D1556, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556 density test at a location already ASTM D6938 tested as

specified herein. Perform an ASTM D1556 density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter.

Bedding and backfill in trenches: One test per 50 linear feet in each lift.

-- End of Section --

SECTION 32 01 11.51

RUBBER AND PAINT REMOVAL FROM AIRFIELD PAVEMENTS
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. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

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

SD-04 Samples

paint removal samples

SD-07 Certificates

Schedule of work

High-pressure rubber and paint removal equipment

1.3 RADIO COMMUNICATION

No personnel or equipment will be allowed on the runway until radio contact has been made with the Control Tower and permission is granted by the Control Tower. A radio for this purpose will be required of the Contractor and approved by the Contracting Officer. The Contractor shall be in contact with the Control Tower at all times during the removal work.

1.4 EMERGENCY LANDINGS AND TAKEOFF

Emergencies shall take precedence over all Contractor operations. Upon notification from the Control Tower of emergency landing or imminent takeoff, all operations shall be stopped immediately and all personnel and equipment evacuated to an area not utilized for aircraft traffic which is at least 200 feet measured perpendicular to and away from the near edge of the runway. Equipment shall be able to clear the work area within 3 minutes.

1.5 ENVIRONMENTAL CONDITIONS

Do not perform work when the temperature is below 40 degrees F, during lightning storms, hail, tornados, or when the pavement is covered with snow or ice.

1.6 SAFETY

Comply with OSHA 29 CFR 1910.

1.8 EQUIPMENT

1.8.1 Equipment Data

Submit descriptive data of high-pressure rubber and paint removal equipment including area of coverage per pass, range of water pressures, and water tank capacity.

1.7 QUALITY ASSURANCE

1.7.1 Required Samples

Prior to the start of work, remove paint on designated test areas not less than 50 feet in length. Use procedures, water pressures, nozzle height, nozzle spacings, nozzle angle, and equipment movement rate to achieve the required degree of paint removal in accordance with the paragraph entitled "Execution." Submit the test results before any further removal work will be allowed.

PART 2 PRODUCTS

2.1 MATERIALS

Water to be used for high-pressure water equipment will be made available from Government hydrants at no cost to the Contractor. Furnish all equipment and labor for delivery of water from the hydrant to the job site. Notify the Contracting Officer on location of fire hydrants to be used and the respective times of use. Connections to a fire hydrant will be subject to the Contracting Officer's inspection and approval.

2.2 EQUIPMENT

Vehicular-mounted hydraulic system capable of delivering high-pressure water impact upon the pavement surface less or greater than 8,000 pounds per square inch. If high-pressure water is delivered from a spray bar, the nozzles shall be spaced to provide total coverage of the area being treated. The nozzle line shall have adjustable pressure regulators or relief valves and gauges measuring actual line pressure. Equipment shall be supported on pneumatic tires. Provide equipment, tools, and machinery which are safe and in satisfactory condition at all times.

PART 3 EXECUTION

3.1 DEGREE OF REMOVAL

Remove 85 percent of loose, flaking paint. Hard, firm paint that has the surface chalk removed may remain.

3.2 RATE OF REMOVAL

Remove paint at a minimum rate of 1,000 square feet per hour. Do not permit high-pressure water application to remove the existing pavement surface.

3.3 WATER PRESSURE

Provide water pressure impact upon the indicated pavement areas sufficient to remove the designated paint to the required degree of removal without damaging the existing pavement joint sealant, and other airfield appurtenances. Contractor shall be responsible for repairing any damage caused by the removal work.

3.4 REMOVAL OF RESIDUE

Remove all residue from the pavement. Obtain the approval of residue removal and disposal method from the Contracting Officer prior to beginning work.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

z

SECTION 32 01 16.17

COLD MILLING OF BITUMINOUS PAVEMENTS
08/08

PART 1 GENERAL

1.3 SYSTEM DESCRIPTION

Maintain in a satisfactory working condition equipment, tools, and machines used in the performance of the work.

1.3.1 Cold-Milling Machine

Provide a cold-milling machine which is self-propelled, capable of milling the pavement to a specified depth and smoothness and of establishing grade control; with means of controlling transverse slope and dust produced during the pavement milling operation. The machine shall have the ability to remove the millings or cuttings from the pavement and load them into a truck. The milling machine shall not cause damage to any part of the pavement structure that is not to be removed.

1.3.2 Cleaning Equipment

Provide cleaning equipment suitable for removing and cleaning loose material from the pavement surface.

1.3.3 Straightedge

Furnish and maintain at the site, in good condition, one 12 foot straightedge or other suitable device for each milling machine, for testing the finished surface. Make straightedge available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal, with blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on the pavement.

1.4 QUALITY ASSURANCE

1.4.1 Grade

Conform the finished milled surfaces to the lines, and grades indicated. The finished milled-pavement surfaces shall vary not more than 1/4 inch from the established plan grade line and elevation. Finished surfaces at a juncture with other pavements shall coincide with the finished surfaces of the abutting pavements. The deviations from the plan grade line and elevation will not be permitted in areas of pavements where closer conformance with planned grade and elevation is required for the proper functioning of appurtenant structures involved.

1.4.2 Surface Smoothness

Finished surfaces shall not deviate from the testing edge of a straightedge more than 1/4 inch in the transverse or longitudinal direction.

1.4.3 Traffic Control

Provide all necessary traffic controls during milling operations.

1.5 ENVIRONMENTAL REQUIREMENTS

Milling shall not be performed when there is accumulation of snow or ice on the pavement surface.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Clean the pavement surface of excessive dirt, clay, or other foreign material immediately prior to milling the pavement.

3.2 MILLING OPERATION

A minimum of seven days notice is required, prior to start work, for the Contracting Officer to coordinate the milling operation with other activities at the site. Make sufficient passes so that the designated area is milled to the grades and cross sections indicated. The milling shall proceed with care and in depth increments that will not damage the pavement below the designated finished grade. Repair or replace, as directed, items damaged during milling such as manholes, valve boxes, utility lines, pavement that is torn, cracked, gouged, broken, or undercut. The milled material shall be removed from the pavement and loaded into trucks.

3.3 REMOVAL OF MILLED MATERIAL

Up to 40 percent of the millings shall be used to stabilize haul routes or placed as directed by the Contracting Officer in areas near or on the airfield. The remainder of the millings shall become the property of the Contractor and removed from the site.

-- End of Section --

SECTION 32 01 17.16

SEALING OF CRACKS IN BITUMINOUS PAVEMENTS
08/08

PART 1 GENERAL

1.1 Payment

Payment will be made at the contract unit bid prices per linear foot for the sealing items scheduled. Include in the unit bid prices the cost of all labor, materials, and the use of all equipment and tools required to complete the work.

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.

ASTM INTERNATIONAL (ASTM)

ASTM C509	(2006; R 2011) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM D6690	(2012) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D789	(2007; E 2010) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)

1.3 SYSTEM DESCRIPTION

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.

1.3.1 Routing Equipment

Provide routing equipment which is a self-powered machine operating a power driven tool or bit specifically designed for routing bituminous pavements. The bit shall rotate about a vertical axis at sufficient speed to cut a smooth vertical-walled reservoir in the pavement surface and shall maintain accurate cutting without damaging the sides or top edges of the reservoir. Provide a router capable of following the trace of the crack without deviation. The use of rotary impact routing devices will not be permitted for cleaning cracks.

1.3.2 Concrete Saw

Provide a self-propelled power saw with small diameter (6 inches or less) water-cooled diamond or abrasive saw blades for cutting cracks to the depths and widths specified and for removing filler that is embedded in the cracks or adhered to the crack faces. The diameter of the saw blade shall be small enough to allow the saw to closely follow the trace of the crack.

1.3.3 Waterblasting Equipment

Include with the waterblasting equipment a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary resupply equipment shall be of sufficient capacity to permit continuous operations. The hose, wand, and nozzle shall be capable of cleaning the crack faces and the pavement surface on both sides of the crack for a width of at least 1/2 inch. A pressure gauge mounted at the pump shall show at all times the pressure in psi at which the equipment is operating.

1.3.4 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from cracks and repairing or cleaning the crack faces.

1.3.5 Crack Sealing Equipment

Provide unit applicators, used for heating and installing the hot-poured crack sealant materials, that are mobile and equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the crack to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. Allow the sealant to circulate through the delivery hose and return to the inner kettle when not in use, due to the applicator unit design.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation of Sealant

SD-04 Samples

Materials; G

SD-06 Test Reports

Test Requirements

1.5 QUALITY ASSURANCE

Test the crack sealant and backup material, when required, for conformance with the referenced applicable material specification. The materials will be tested by the Government. Submit samples of the materials 30 days prior to their use on the project. No material will be allowed to be used until it has been approved. The cost of the first test of samples will be borne by the Government. If the samples fail to meet specification requirements, replace the materials represented by the sample and test the new materials at the Contractor's expense. Furnish samples of materials, in sufficient

quantity to be tested upon request. Conformance with the test requirements of the laboratory tests specified will not constitute final acceptance of the materials. Submit reports of all tests. Perform testing of the materials in an approved, independent laboratory; submit certified copies of the test reports for approval 30 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing, should the materials appear defective during or after application. Final acceptance will be based on the performance of the in-place materials.

1.6 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the job site for defects; unload, and store them with a minimum of handling to avoid damage. Provide storage facilities at the job site to protect materials from weather and to maintain them at the temperatures recommended by the manufacturer.

1.7 ENVIRONMENTAL REQUIREMENTS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Do not apply sealant if moisture is observed in the crack.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealants conforming to ASTM D6690, Type II or ASTM D6690, Type I.

2.2 BACKUP MATERIALS

Provide backup material that is a compressible, nonshrinking, nonstaining, nonabsorptive material and nonreactive with the crack sealant. The melting point of the backing material shall be at least 5 degrees F greater than the maximum pouring temperature of the sealant being used, when tested in accordance with ASTM D789. The material shall have a water absorption of not more than 5 percent by weight when tested in accordance with ASTM C509. The backup material shall be 25 percent (plus or minus 5 percent) larger in diameter than the nominal width of the crack.

PART 3 EXECUTION

3.1 PREPARATION OF CRACKS

Immediately before the installation of the crack sealant, thoroughly clean the cracks to remove oxidized pavement, loose aggregate and foreign debris. The preparation shall be as follows:

3.1.1 Cracks

3.1.1.1 Hairline Cracks

Cracks that are less than 1/4 inch wide do not need to be sealed.

3.1.1.2 Small Cracks

Cracks that are 1/4 to 3/4 inch wide shall be routed to a nominal width 1/8 inch greater than the existing nominal width and to a depth not less than

3/4 inch, waterblasted and cleaned using compressed air.

3.1.1.3 Medium Cracks

Cracks that are 3/4 to 2 inches wide shall be waterblasted and cleaned using compressed air.

3.1.1.4 Large Cracks

Cracks that are greater than 2 inches wide shall be repaired using pothole repair techniques instead of sealing.

3.1.2 Existing Sealant Removal

Cut loose the in-place sealant from both crack faces and to a depth shown on the drawings, using a concrete saw or hand tools as specified in paragraph EQUIPMENT. Depth shall be sufficient to accommodate any backup material that is required to maintain the depth of new sealant to be installed. Prior to further cleaning operations, remove all old loose sealant remaining in the crack opening by blowing with compressed air.

3.1.3 Routing

Perform routing of the cracks using a rotary router with a bit that is at least 1/8 inch wider than the nominal width of the crack to remove all residual old sealant (resealing), oxidized pavement and any loose aggregate in the crack wall.

3.1.4 Sawing

Perform sawing of the cracks using a power-driving concrete saw as specified in paragraph EQUIPMENT. Stiffen the blade as necessary with suitable dummy (or used) blades or washers. Immediately following the sawing operation, clean the crack opening using a water jet to remove all saw cuttings and debris.

3.1.5 Backup Material

Use backup material on all cracks that have a depth greater than 3/4 inch. Insert the backup material into the lower portion of the crack as shown on the drawings. Ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.1.6 Rate of Progress of Crack Preparation

Limit the stages of crack preparation, which include routing, waterblasting of the crack faces, air pressure cleaning and placing of the backup material, to only that linear footage that can be sealed during the same day.

3.2 PREPARATION OF SEALANT

Do not heat hot-poured sealants in excess of the safe heating temperature recommended by the manufacturer, as shown on the sealant containers. Withdraw and waste sealant that has been overheated or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation.

3.3 INSTALLATION OF SEALANT

Submit manufacturer's instructions 30 days prior to the use of the material on the project. Installation of the material will not be allowed until the instructions are received.

3.3.1 Time of Application

Seal cracks immediately following final cleaning of the crack walls and following the placement of the backup material (when required). Cracks that cannot be sealed under the conditions specified, or when rain interrupts sealing operations, shall be recleaned and allowed to dry prior to installing the sealant.

3.3.2 Sealing the Crack

Immediately preceding, but not more than 50 feet ahead of the crack sealing operations, perform a final cleaning with compressed air. Fill the cracks from the bottom up to 1/4 inch below the pavement surface. Remove excess or spilled sealant from the pavement by approved methods and discard it. Install the sealant in a manner which prevents the formation of voids and entrapped air. Several passes with the applicator wand may be necessary to obtain the specified sealant depth from the pavement surface. Do not use gravity methods or pouring pots to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. Cracks shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within 3 hours.

3.4 CRACK SEALANT INSTALLATION TEST SECTION

Prior to the cleaning and sealing of the cracks for the entire project, construct a test section at least 200 feet long using the specified materials and approved equipment, to demonstrate the proposed sealing of all cracks of the project. Following the completion of the test section and before any other crack is sealed, inspect the test section to determine that the materials and installation meet the requirements specified. If materials or installation do not meet requirements, remove the materials and reclean and reseal the cracks at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. Seal all other cracks in the manner approved for sealing the test section.

3.5 CLEANUP

Upon completion of the project, remove unused materials from the site and leave the pavement in a clean condition.

3.6 QUALITY CONTROL PROVISIONS

3.6.1 Crack Cleaning

Provide quality control provisions during the crack cleaning process to correct improper equipment and cleaning techniques that damage the bituminous pavement in any manner. Cleaned cracks shall be approved prior to installation of the crack sealant.

3.6.2 Crack Seal Application Equipment

Inspect the application equipment to ensure conformance to temperature requirements and proper installation. Evidences of bubbling, improper installing, and failing to cure or set will cause to suspend operations until causes of the deficiencies are determined and corrected.

3.6.3 Crack Sealant

Inspect the crack sealant for proper cure and set rating, bonding to the bituminous pavement, cohesive separation within the sealant, reversion to liquid, and entrapped air and voids. Sealants exhibiting any of these deficiencies, at any time prior to the final acceptance of the project, shall be removed from the crack, wasted, and replaced as specified herein at no additional cost to the Government.

-- End of Section --

SECTION 32 01 19.61

RESEALING OF JOINTS IN RIGID PAVEMENT
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 SS-S-200	(Rev E; Am 1; Notice 1) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Joint sealant

Submit catalog cuts, specifications, material Safety Data Sheets and other information documenting conformance to contract requirements.

SD-04 Samples

Joint filler

Separating tape

Joint backer rod

Joint sealant

Submit catalog cuts, specifications, and Material Safety Data Sheets (MSDS) of each joint seal with associated primer to the Contracting Officer a minimum of 60 days prior to its use on the job.

Name of sealant

Identification of component, or primer

Specification number and type

Manufacturer's name

Manufacturer's lot and batch number

Date of Manufacture (month and year)

Shelf life retest date (month and year)

List of hazardous components

Storage instructions

Instructions for use

SD-06 Test Reports

Joint sealant

SD-07 Certificates

Equipment list

SD-08 Manufacturer's Instructions

Joint sealant

Instructions shall include, but not be limited to: storage requirements, ambient temperature and humidity ranges, and moisture condition of joints for successful installation; requirements for preparation of joints; safe heating temperature; mixing instructions; installation equipment and procedures; application and disposal requirements; compatibility of sealant with filler material; curing requirements; and restrictions to be adhered to in order to reduce hazards to personnel or to the environment. Submit instructions at least 30 days prior to use.

1.3 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for visible damage, and unload and store with a minimum of handling. Joint materials shall be delivered in original sealed containers and shall be protected from freezing or overheating. Provide jobsite storage facilities capable of maintaining temperature ranges within manufacturers recommendations.

1.4 ENVIRONMENTAL REQUIREMENTS

Work shall not proceed when weather conditions detrimentally affect the quality of cleaning joints or applying joint sealants. Joint preparation and sealing shall proceed only when weather conditions are in accordance with manufacturer's instructions. During installation, surfaces shall be dry and sealant and bond breakers shall be protected from moisture.

1.5 TRAFFIC CONTROL

Do not permit vehicular or heavy equipment traffic on the pavement in the area of the joints being sealed during the protection and curing period of the joint sealant. At the end of the curing period, traffic may be permitted on the pavement when approved.

1.6 EQUIPMENT

Submit a equipment list and description of the equipment to be used and a statement from the supplier of the joint sealant that the proposed equipment is acceptable for installing the specified sealant. Equipment for heating, mixing, and installing joint seals shall be in accordance with the instructions provided by the joint seal manufacturer. Furnish equipment, tools, and accessories necessary to clean existing joints and install liquid joint sealants. Maintain machines, tools, and other equipment in proper working condition.

1.6.1 Joint Cleaning Equipment

1.6.1.1 Routing Tool

To remove old sealant from joints, select rectangular shaped routing tool that is adjustable to varying widths and depths required. The equipment shall be capable of maintaining accurate cutting depth and width control. The joint plow shall be equipped with a spring or hydraulic mechanism to release pressure on the tool prior to spalling the concrete.

1.6.1.2 Concrete Saw

Self-propelled power saw with diamond saw blades designed for sawing, refacing, widening, or deepening existing joints as specified without damaging the sides, bottom, or top edge of joints. Blades may be single or gang type with one or more blades mounted in tandem for fast cutting. Select saw adequately powered and sized to cut specified opening with not more than two passes of the saw through the joint.

1.6.1.3 Air Compressor

Portable air compressor capable of operating the sandblasting equipment and capable of blowing out sand, water, dust adhering to sidewalls of concrete, and other objectionable materials from the joints. The compressor shall furnish air at a pressure not less than 90 psi and a minimum rate of 150 cubic feet of air per minute at the nozzles and free of oil.

1.6.1.4 Vacuum Sweeper

Self-propelled, vacuum pickup sweeper capable of completely removing loose sand, water, joint material, and debris from pavement surface.

1.6.1.5 Hand Tools

When approved, hand tools such as brooms and chisels may be used in small areas for removing old sealant from joints and repairing or cleaning the joint faces.

1.6.2 Joint Sealing Equipment

REFER TO SECTION 32 01 19.

Joint sealing equipment shall be of a type required by the joint seal manufacturer's installation instructions. Equipment shall be capable of installing sealant to the depths, widths and tolerances indicated. When malfunctions are noted, joint sealing shall not proceed until they are corrected.

1.6.2.1 Two-Component Cold-Applied Liquid Sealants

For two component cold applied machine mixed sealants the equipment shall be capable of delivering each component within an accuracy of 5 percent. Equip reservoirs for each component with mechanical agitation devices. Equip equipment with thermostatically controlled indirect heating of components when required. Equipment shall include screens over each reservoir to eliminate foreign particles or partially polymerized material which may clog lines. Equipment shall be capable of intimately mixing the two components through a range of application rates from 10 to 60 gallons per hour and through a range of pressures from 50 to 150 pounds per square inch. Hand-mixing of cold-applied two component sealant may be done at the option of the Contractor for sealants conforming to FS SS-S-200, Type H.

1.6.2.2 Equipment for Silicone Sealant

Equipment for silicone sealant shall be air powered pump, components, and hoses as recommended by the sealant manufacturer. Hoses and seals shall be lined to prevent moisture penetration and withstand pumping pressures. Equipment shall be free of contamination from previously used or other type sealant.

1.7 SAFETY PROVISIONS

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Joint Sealant

REFER TO SECTION 32 01 19.

PART 3 EXECUTION

3.1 JOINT PREPARATION

Unless otherwise indicated, remove existing material, saw, clean and reseal joints. Do not proceed with final cleaning operations by more than one working day in advance of sealant. Thoroughly clean joints by removing existing joint sealing compound, bond-breakers, dirt, and other foreign material with the equipment specified herein, but not limited thereto. Cleaning procedures which damage joints or previously repaired patches by chipping or spalling will not be permitted. Damaged joints shall be repaired at no expense to the government. Remove existing sealant to the required depth . Precise shape and size of existing joints vary, and conditions of joint walls and edges vary and include but are not limited to rounding, square edges, sloping, chips, voids, depressions, and projections.

3.1.1 Removal of Existing Material

Remove from the joint the existing sealants by using the specified routing tool. After cutting free the existing sealant from both joint faces, remove sealant to the depth required to accommodate the bond breaking material and to maintain the specified depth for the new sealant. For expansion joints, remove existing sealant to a depth of not less than one inch. When existing preformed expansion-joint material is more than one inch below the surface of the pavement, remove existing sealant to the top of the preformed joint filler. For joints other than expansion joints, remove in-place sealant to the required depth. At the completion of

routing operations, clean pavement surface with vacuum sweeper and clean the joint opening by blowing with compressed air. Protect previously cleaned joints from being contaminated by subsequent cleaning operations.

3.1.2 Refacing of Joints

Reface concrete joint walls. Re-saw joint grooves to the dimensions indicated. Refacing shall be by power-driven concrete saw specified herein to remove residual sealant and a minimum of concrete. Removal shall provide exposure of newly clean concrete. Remove burrs and irregularities from sides of joint faces. Immediately after sawing each joint, thoroughly clean saw cut and adjacent concrete surface. Flush with water under pressure, simultaneously blowing water out with compressed air until debris is removed from the joint. Protect adjacent previously cleaned joint spaces from receiving water and debris during the cleaning operation.

3.1.2.1 Joint Widening (Except Expansion Joints)

Saw joints having grooves less than 3/8 inch wide and less than one inch deep to a minimum width of 3/8 inch and to the minimum depth, as indicated.

3.1.3 Bond Breaker

At the time the joints receive the final cleaning and are dry, install bond breaker material as indicated with a steel wheel or other approved device.

3.1.3.1 Blocking Media (Backer Rod) (Except for Expansion Joints)

Plug or seal off the lower portion of the groove by installing the specified blocking media as indicated.

3.1.4 Rate of Progress

The final stages of joint preparation, which include placement of bond breakers, if required, shall be limited to only that length of joint that can be resealed during the same workday.

3.1.5 Disposal of Debris

Sweep from pavement surface to remove excess joint material, dirt, water, sand, and other debris by vacuum sweepers or hand brooms. Remove the debris immediately in accordance with Section 02 41 00 DEMOLITION.

3.2 PREPARATION OF SEALANT

3.2.1 Cold-Applied, Two Component Type

Reject materials which contain water, hard caking of separated constituents, nonreversible jell, or other unsatisfactory conditions such as settlement of constituents into a soft mass that cannot be readily and uniformly remixed in the field with simple tools. In conformance with the manufacturer's recommendations, mix individual components in separate shipping containers before transferring components to appropriate reservoirs of application equipment. Thoroughly mix components to ensure homogeneity of components and incorporation of constituents at time of transfer. When necessary, for remixing prior to transfer, warm components to a temperature not exceeding 90 degrees F by placing components in heated storage or by other approved methods. In no case shall components be heated by direct flame or in single-walled, non-oil-bath heating kettles.

3.3 INSTALLATION OF SEALANT

3.3.1 Test Section

Install a test section of 200 linear feet at the start of the sealing operation for each type sealant to be used. Test section shall meet contract requirements. The Contracting Officer shall be notified upon completion of the test section.

3.3.2 Time of Application

After approval of the test section, seal joints immediately following final cleaning and placing of bond breakers. Commence sealing joints when walls are dust free and dry, and when weather conditions meet joint seal manufacturer's instructions. If the above conditions cannot be met, or when rains interrupts sealing operations, reclean and permit the joints to dry prior to installing the sealant.

3.3.3 Sealing the Joints

Do not install joint sealant until joints to be sealed have been inspected and approved. Install bond breaker just prior to pouring sealant. Fill the joints with sealant from bottom up until joints are uniformly filled solid from bottom to top using the specified equipment for the type of sealant required. Fill joints to 1/4 inch below top of pavement within tolerances as indicated, and without formation of voids or entrapped air. Except as otherwise permitted, tool the sealant immediately after application to provide firm contact with the joint walls and to form the indicated sealant profile below the pavement surface. Remove excess sealant that has been inadvertently spilled on the pavement surface. When two-component sealants are placed, each day check hourly the proportioning capability of the equipment to determine that the preset volume output for each component is being maintained. The material used for these checks may be returned to the proper component reservoir. In no case shall two component sealants be installed using gravity methods and pouring spouts, except for approved hand mixing methods. When a primer is supplied or recommended by the manufacturer of a two component sealant, apply the primer evenly to the joint faces in accordance with the manufacturer's recommendations. Check sealed joints frequently to assure that newly installed sealant is cured to a tack-free condition within 3 hours. Protect new sealant from rain during curing period.

3.4 FIELD QUALITY CONTROL

3.4.1 Joints

Inspect and approve joints which have been cleaned and have backer rods or bond breaking tape installed prior to sealing.

3.4.2 Joint Seal Test Section

Inspect joint seal test section Correct deficiencies and obtain approval of test section by the Contracting Officer prior to installing joint seals.

3.4.3 Joint Sealer

Inspect installed joint seals for conformance to contract requirements, joint seal manufacturer's instructions, and the test section. Obtain

approval for each joint seal installation.

3.5 ACCEPTANCE

Reject joint sealer that fails to cure properly, or fails to bond to joint walls, or reverts to the uncured state, or fails in cohesion, or shows excessive air voids, blisters, surface defects, swelling, or other deficiencies, or is not properly recessed within indicated tolerances. Remove rejected sealer and reclean and reseal joints in accordance with the specification. Perform removal and reseal work promptly by and at the expense of the Contractor.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 32 01 19

FIELD MOLDED SEALANTS FOR SEALING JOINTS IN AND REPAIRED CRACKS RIGID PAVEMENTS
08/08

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.

ASTM INTERNATIONAL (ASTM)

ASTM C1016	(2014) Standard Test Method for Determination of Water Absorption of Sealant Backing (Joint Filler) Material
ASTM D789	(2007; E 2010) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-200	(Rev E; Am 1; Notice 1) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Recommendations; G.
Equipment.

SD-04 Samples

Materials; G.

SD-06 Test Reports

Certified copies of the test reports; G.

1.3 QUALITY ASSURANCE

1.3.1 Test Requirements

Test the joint sealant and backup or separating material for conformance with the referenced applicable material specification. Perform testing of

the materials in an approved independent laboratory and submit certified copies of the test reports for approval 14 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing should the materials appear defective during or after application. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials. Submit samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing and approval 30 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

1.3.2 Trial Joint Sealant Installation

Prior to the cleaning and sealing of the joints for the entire project, prepare a test section at least 200 feet long using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, inspect the test section to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, remove the materials, and reclean and reseal the joints at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. Prepare and seal all other joints in the manner approved for sealing the test section.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the job site for defects, unload, and store them with a minimum of handling to avoid damage. Provide storage facilities at the job site for maintaining materials at the temperatures and conditions recommended by the manufacturer.

1.5 ENVIRONMENTAL REQUIREMENTS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Do not apply sealant if moisture is observed in the joint.

PART 2 PRODUCTS

2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall conform to FS SS-S-200 Type M.

2.2 PRIMERS

When primers are recommended by the manufacturer of the sealant, use them in accordance with the recommendation of the manufacturer.

2.3 BACKUP MATERIALS

Provide backup material that is a compressible, nonshrinking, nonstaining, nonabsorbing material, nonreactive with the joint sealant. The material shall have a melting point at least 5 degrees F greater than the pouring

temperature of the sealant being used when tested in accordance with ASTM D789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C1016. Use backup material that is 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

2.4 BOND BREAKING TAPES

Provide a bond breaking tape or separating material that is a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to the joint sealant.

PART 3 EXECUTION

3.1 EXECUTING EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, 30 days prior to use on the project.

3.1.1 Joint Cleaning Equipment

3.1.1.1 Tractor-Mounted Routing Tool

Provide a routing tool, used for removing old sealant from the joints, of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

3.1.1.2 Concrete Saw

For new concrete construction, refer to Section 32 13 11 SAWINL EQUIPMENT.

3.1.1.3 Waterblasting Equipment

Include with the waterblasting equipment a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water resupply equipment. Provide water tank and auxiliary resupply equipment of sufficient capacity to permit continuous operations. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. Adjust the height, angle of inclination and the size of the nozzle as necessary to obtain satisfactory results. A pressure gauge mounted at the pump shall show at all times the pressure in psi at which the equipment is operating.

3.1.1.4 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.

3.1.2 Sealing Equipment

3.1.2.1 Two-Component, Cold-Applied, Machine Mix Sealing Equipment

Provide equipment used for proportioning, mixing, and installing FS SS-S-200 Type M joint sealants designed to deliver two semifluid components through hoses to a portable mixer at a preset ratio of 1 to 1 by volume using pumps with an accuracy of plus or minus 5 percent for the quantity of each component. The reservoir for each component shall be equipped with mechanical agitation devices that will maintain the components in a uniform condition without entrapping air. Incorporate provisions to permit thermostatically controlled indirect heating of the components, when required. However, immediately prior to proportioning and mixing, the temperature of either component shall not exceed 90 degrees F. Provide screens near the top of each reservoir to remove any foreign particles or partially polymerized material that could clog fluid lines or otherwise cause misproportioning or improper mixing of the two components. Provide equipment capable of thoroughly mixing the two components through a range of application rates of 10 to 60 gallons per hour and through a range of application pressures from 50 to 1500 psi as required by material, climatic, or operating conditions. Design the mixer for the easy removal of the supply lines for cleaning and proportioning of the components. The mixing head shall accommodate nozzles of different types and sizes as may be required by various operations. The dimensions of the nozzle shall be such that the nozzle tip will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval.

3.2 SAFETY

Do not place joint sealant within 25 feet of any liquid oxygen (LOX) equipment, LOX storage, or LOX piping. Thoroughly clean joints in this area and leave them unsealed.

3.3 PREPARATION OF JOINTS

Immediately before the installation of the sealant, thoroughly clean the joints to remove all laitance, curing compound, filler, protrusions of hardened concrete, and old sealant from the sides and upper edges of the joint space to be sealed.

3.3.1 Existing Sealant Removal

Cut loose the in-place sealant from both joint faces and to the depth shown on the drawings, using the concrete sawor waterblaster as specified in paragraph EQUIPMENT. Depth shall be sufficient to accommodate any separating or backup material that is required to maintain the depth of new sealant to be installed. Prior to further cleaning operations, remove all loose old sealant remaining in the joint opening by blowing with compressed air. Hand tools may be required to remove sealant from random cracks. Chipping, spalling, or otherwise damaging the concrete will not be allowed.

3.3.2 Sawing

3.3.2.1 Refacing of Joints

Accomplish refacing of joints using a concrete saw as specified in

paragraph EQUIPMENT to remove all residual old sealant and a minimum of concrete from the joint face to provide exposure of newly cleaned concrete, and, if required, to enlarge the joint opening to the width and depth shown on the drawings. Stiffen the blade with a sufficient number of suitable dummy (used) blades or washers. Thoroughly clean, immediately following the sawing operation, the joint opening using a water jet to remove all saw cuttings and debris.

3.3.2.2 Refacing of Random Cracks

Accomplish sawing of the cracks using a power-driven concrete saw as specified in paragraph EQUIPMENT. The saw blade shall be 6 inches or less in diameter to enable the saw to follow the trace of the crack. Stiffen the blade, as necessary, with suitable dummy (or used) blades or washers. Immediately following the sawing operation, thoroughly clean the crack opening using a water jet to remove all saw cuttings and debris.

3.3.3 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a back-up material to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.3.4 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond breaker separating tape to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will not float up into the new sealant.

3.3.5 Rate of Progress of Joint Preparation

Limit the stages of joint preparation, which include sandblasting, air pressure cleaning and placing of the back-up material to only that lineal footage that can be sealed during the same day.

3.4 PREPARATION OF SEALANT

3.4.1 Type M Sealants

Inspect the FS SS-S-200 Type M sealant components and containers prior to use. Reject any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection. Prior to transfer of the components from the shipping containers to the appropriate reservoir of the application equipment, thoroughly mix the materials to ensure homogeneity of the components and incorporation of all constituents at the time of transfer. When necessary for remixing prior to transfer to the application equipment reservoirs, warm the components to a temperature not to exceed 90 degrees F by placing the components in heated storage or by other approved methods but in no case shall the components be heated by direct flame, or in a single walled kettle, or a kettle without an oil bath.

3.5 INSTALLATION OF SEALANT

3.5.1 Time of Application

Seal joints immediately following final cleaning of the joint walls and following the placement of the separating or backup material. Open joints, that cannot be sealed under the conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

3.5.2 Sealing Joints

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning with compressed air. Fill the joints from the bottom up to 1/4 inch plus or minus 1/16 inch below the pavement surface. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.6 INSPECTION

3.6.1 Joint Cleaning

Inspect joints during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints will be approved prior to installation of the separating or back-up material and joint sealant.

3.6.2 Joint Sealant Application Equipment

Inspect the application equipment to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component sealant) and proper installation. Evidences of bubbling, improper installation, failure to cure or set will be cause to suspend operations until causes of the deficiencies are determined and corrected.

3.6.3 Joint Sealant

Inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Government.

3.7 CLEAN-UP

Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

-- End of Section --

SECTION 32 01 29.61

PARTIAL DEPTH PATCHING OF RIGID PAVING
11/08

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
AASHTO SDDP-1-OL	(2003) Shop Detail Drawing Presentation Guidelines

ASTM INTERNATIONAL (ASTM)

ASTM C1059/C1059M	(2013) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C131/C131M	(2014) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143/C143M	(2012) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C1581/C1581M	(2009a) Standard Test Method for Determining Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C171	(2007) Standard Specification for Sheet

	Materials for Curing Concrete
ASTM C173/C173M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2014) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2014a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C469/C469M	(2014) Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
ASTM C494/C494M	(2013) Standard Specification for Chemical Admixtures for Concrete
ASTM C531	(2000; R 2012) Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings, and Polymer Concretes
ASTM C666/C666M	(2003; R 2008) Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685/C685M	(2011) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C881/C881M	(2013) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C882/C882M	(2013a) Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C94/C94M	(2014b) Standard Specification for Ready-Mixed Concrete

ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 300	(1990) Specifications for Membrane-Forming Compounds for Curing Concrete

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

29 CFR 1910	Occupational Safety and Health Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. 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

SD-03 Product Data

Mix Design; G

Pigmented Liquid Membrane-Forming Compound; G

SD-04 Samples

Absorbent curing material; G
Joint filler; G
Joint sealant; G

SD-05 Design Data

Concrete Mix Design; G

SD-06 Test Reports

Laboratory Test Results
Aggregates gradation
Cement
Concrete slump
Concrete air content
Concrete strength (cylinder)
Mixer Calibration and Efficiency

SD-07 Certificates

Cement
Aggregate
Admixtures
Absorbent curing material
Pigmented Liquid Membrane-Forming Compound
Waterproof Sheet
Joint Filler
Joint Sealant

1.3 QUALITY ASSURANCE

1.3.1 Preconstruction Testing Of Materials

Submit proposed concrete mix design at least 15 days prior to placement. Provide mix design evaluation and certification by an approved engineering testing laboratory, and indicate the weight of each ingredient of the mixture, aggregate gradation, slump, air content, water-cement ratio, and 7-day and 28-day compressive strength test results. Include a complete list of materials including admixtures and applicable reference specifications. Place no concrete prior to approval of the proposed mix design. No deviation from the approved mix design is permitted without prior approval.

Within 24 hours of physical completion of laboratory testing, submit copies of test results for approval.

1.3.1.1 Cement

Test cement as prescribed in the referenced specification under which it is furnished. Cement may be accepted on the basis of mill tests and the manufacturer's certification of compliance with the specification.

1.3.1.2 Aggregate

Take aggregate gradation samples for laboratory testing in conformance with ASTM D75/D75M.

1.3.1.3 Proprietary Cementitious Products and Epoxy

At least 30 days before the material is used, submit certified copies of test results for the specific lots or batches to be used on the project, not more than 6 months old prior to use in the work.

Manufacturer's certifications may be submitted rather than laboratory test results for proprietary cementitious products. Include in the instructions details for substrate preparation, mixing, placing, finishing, curing and testing of the material. Include a minimum of three case histories documenting the use of the product in a similar freeze-thaw environment and airfield pavement condition. Certify compliance with the appropriate specification referenced herein. Place no materials without prior approval from the Contracting Officer.

1.3.2 Equipment; Approval, Maintenance, and Safety

Provide and use only dependable and well maintained equipment that is appropriate to accomplish the work specified. Allow sufficient time for assembly of equipment requiring such at the work site to permit thorough inspection, calibration of weighing and measuring devices, adjustment of

parts, and the making of any repairs that may be required prior to the start of work.

a. Submit volumetric mixer calibration and efficiency test results. Results must be current within 6 months of concrete placement.

b. Provide Material Safety Data Sheets (MSDS) and Personal Protection Equipment (PPE) per 29 CFR 1910.

Submit detailed Shop Drawings conforming to AASHTO SDDP-1-OL.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Cement

Deliver cement in bulk or in suitable bags used for packaging cements and store in a manner to prevent absorption of moisture.

1.4.2 Aggregate

Deliver, handle, and store aggregate in a manner to avoid breakage, segregation, or contamination by foreign materials.

1.4.3 Other Materials

Deliver epoxy-resin, chemical admixtures and proprietary cementitious products to the site in such manner as to avoid damage or loss. Provide storage areas in a windowless and weatherproof, but ventilated, insulated noncombustible building, with provision nearby for conditioning the material to 70 to 85 degrees F for a period of 48 hours prior to use. Keep the ambient temperature in the storage area no higher than 100 degrees F.

1.5 Project/Site Conditions

Do not place concrete when weather conditions detrimentally affect the quality of the finished product. Do not place concrete when the air temperature is below 40 degrees F in the shade. When air temperature is likely to exceed 90 degrees F, provide concrete having a temperature not exceeding 90 degrees F when deposited. Keep the surface of placed concrete damp with a water fog until the approved curing medium is applied.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Coarse Aggregate

2.1.1.1 Composition

Provide coarse aggregate consisting of gravel, crushed gravel, crushed stone, or a combination thereof.

2.1.1.2 Quality

Provide aggregate , as delivered to the mixers, consisting of clean, hard, unweathered, and uncoated particles. Remove dust and other coatings from the coarse aggregate by adequate washing. Meet the requirements of ASTM C33/C33M, Class 4S for deleterious substances. Abrasion loss, when

tested in accordance with ASTM C131/C131M, must not exceed 40 percent; the maximum allowable percentage for clay lumps and friable particles is 1.5 percent. Provide documentation of aggregate conforming to ASTM C136.

2.1.1.3 Particle Shape

Provide spherical or cubical shaped coarse aggregate particles.

2.1.1.4 Gradation

The maximum nominal size of the coarse aggregate is 1/2 inch. Provide well graded coarse aggregate, within the limits specified, and tested in accordance with ASTM C136, and conforming to the following grading requirements as delivered to the batching hoppers:

Sieve designation U.S. Standard square mesh	Percentage by weight passing individual sieves No. 4 to 1/2
3/4 inch	100
1/2 inch	90-100
3/8 inch	40-70
No. 4	0-15
No. 8	0-5

2.1.1.5 Alkali Silica Reactivity

Evaluate and test coarse aggregate, to be used in all concrete, for alkali-silica reactivity in accordance with ASTM C1260. Measured expansion must not exceed 0.08 percent at 28 days when tested. Test data indicating an expansion greater than 0.08 percent will be rejected.

Evaluate coarse aggregate in accordance with Section 32 13 11, paragraph: Alkali-Silica Reactivity, with mitigation of reactive aggregate in accordance with the referenced paragraph.

2.1.2 Fine Aggregate

2.1.2.1 Composition

Provide fine aggregate consisting of either natural sand, manufactured sand, or a combination of natural and manufactured sand, and composed of clean, hard, durable particles; conforming to ASTM C33/C33M, Table 1 for deleterious substances.

2.1.2.2 Particle Shape and Quality

Ensure particles of the fine aggregate are generally spherical or cubical in shape.

2.1.2.3 Grading

Conform grading of the fine aggregate as delivered to the mixer to the following requirements when tested in accordance with ASTM C136.

Sieve designation U.S. Standard square mesh	Percentage by weight passing
3/8 inch	100
No. 4	95-100
No. 8	80-90
No. 16	60-80
No. 30	30-60
No. 50	12-30
No. 100	2-10

In addition, provide fine aggregate, as delivered to the mixer, with a fineness modulus of not less than 2.40 nor more than 2.90, when calculated in accordance with ASTM C136.

2.1.2.4 Alkali Silica Reactivity

Evaluate and test fine aggregate to be used in all concrete for alkali-silica reactivity using the procedures described for coarse aggregate.

2.1.3 Admixtures

2.1.3.1 Air-Entraining Admixtures

Provide air-entraining admixtures conforming to ASTM C260/C260M.

2.1.3.2 Chemical Admixtures

ASTM C494/C494M. Where not shown or specified, the use of admixtures is subject to written approval of the Contracting Officer.

2.1.4 Cement

Provide portland cement conforming to ASTM C150/C150M, Type _III_. Provide low alkali cement if the proposed fine or coarse aggregate are found to have greater than 0.04 percent expansion when tested in accordance with paragraphs: Alkali Silica Reactivity.

2.1.4.1 Portland Cement Mix Design

Design the concrete mixture to produce a minimum compressive strength of 5,000 psi at 28 days of age, determined in conformance with ASTM C39/C39M and ASTM C192/C192M, using standard 6 by 12 inch cylinder specimens; and providing an air content by volume of 5 percent, plus or minus 1.5 percent, based on measurements made on concrete immediately after discharge from the mixer in conformance with ASTM C231/C231M.

The allowable range of slump is 1/2 to 2 inches when tested in accordance with ASTM C143/C143M . To minimize drying shrinkage, the maximum water-cement ratio by weight is 0.45.

2.1.5 Curing Materials

2.1.5.1 Burlap

Provide burlap conforming to AASHTO M 182.

2.1.5.2 Pigmented Liquid Membrane-Forming Compound

Provide pigmented liquid membrane-forming compound conforming to COE CRD-C 300ASTM C309.

2.1.5.3 Waterproof Sheet Materials

Provide waterproof sheet materials conforming to ASTM C171, Type optional, color white.

2.1.6 Bonding-Agents

2.1.6.1 Epoxy-Resin

Provide two component epoxy-resin material formulated to meet the requirements of ASTM C881/C881M, Type III, grade and class as approved, for use in bond coat applications and as a component of epoxy-resin concrete or mortar.

Mix epoxy-resin grout components in the proportions recommended by the manufacturer. Condition the components to 70 to 85 degrees F for 48 hours prior to mixing. Mix the two epoxy components with a power-driven, explosion-proof stirring device in a metal or polyethylene container having a hemispherical bottom. Add the curing-agent component gradually to the epoxy-resin component with constant stirring until a uniform mixture is obtained. Stir such that the rate of entrained air is a minimum.

2.1.6.2 Latex

Provide latex bonding agent meeting the requirements of ASTM C1059/C1059M, Type II.

2.1.7 Joint Sealant

Provide joint sealant as as specified in Section 32 01 19.61 RESEALING OF JOINTS IN RIGID PAVING.

2.1.8 Joint Filler

Provide joint filler material conforming to ASTM D1751 or ASTM D1752, Type II.

2.1.9 Water

Use only clean, fresh water, free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances. Water approved by Public Health authorities for domestic consumption may be accepted for use without being tested. Test water that is of questionable quality, in the opinion of the Contracting Officer, in accordance with ASTM C1602/C1602M and acceptance criteria of Table 1 of ASTM C94/C94M.

2.1.10 Proprietary Cementitious Products

A proprietary cementitious product is defined as a rigid material in its hardened state with an elastic modulus greater than 1,000,000 psi. Maximum size of aggregate used to extend the product is 3/4 inch. Test the product in accordance with the following test series. Replicate each test on three specimens. Report all three results for each test and use the average value for comparison with the specification requirements. Report the curing conditions for each test type.

2.1.10.1 Compressive Strength

Cast 3 by 6 inch cylinder specimens in accordance with ASTM C192/C192M and test in accordance with ASTM C39/C39M, using bonded or unbonded caps, after 3 hours and 1 day curing period. A minimum compressive strength of 3500 psi is required at 3 hours and 1 day of age.

2.1.10.2 Bond Strength

Cast 3 by 6 inch cylinder specimens and test in accordance with ASTM C882/C882M. Cast the candidate material against a 30-degree wedge specimen consisting of the candidate material itself or an ordinary portland cement mixture. Test specimens, using bonded caps, after 1 day curing period. For a bond consisting of the candidate material bonded to OPC mortar, a minimum bond strength of 500 psi is required at 1 day of age. For a bond consisting of the candidate material bonded to itself, a minimum bond strength of 1000 psi is required at 1 day of age.

2.1.10.3 Modulus of Elasticity

Cast 6 by 12 inch cylinder specimens in accordance with ASTM C192/C192M and test in accordance with ASTM C469/C469M, using bonded caps, after 3 day curing period. A maximum chord modulus of elasticity of 4,000,000 psi is required at 3 days of age.

2.1.10.4 Coefficient of Thermal Expansion

Cast 1 by 1 by 10-inches prismatic bar specimens and test in accordance with ASTM C531, after 3 days curing period. A maximum coefficient of 7 by 10^{-6} inch per inch per degree F is required at 3 days of age.

2.1.10.5 Shrinkage Potential

Cast 13 inch I.D. by 16 inch O.D. by 6 inch tall restrained toroidal specimens and test in accordance with ASTM C1581/C1581M. Start measuring strain after completion of casting. A maximum of 40 microstrain is required at 14 days of age. No cracking is permitted at 28 days of age.

2.1.10.6 Freeze-Thaw Resistance

Cast prismatic specimens in accordance with ASTM C192/C192M and test in accordance with ASTM C666/C666M, Procedure A. Begin freeze-thaw testing after specimens have been immersed in saturated lime-water for 3 days. Report the Durability Factor (DF) and the number of cycles to failure.

2.2 Neat Cement Grout

2.2.1 Sand-Cement Grout Bonding Course

Provide grout bonding course consisting of equal parts of Type I or II, portland cement and sand by dry weight, thoroughly mixed with water to yield a thick, creamy mixture; with a water-cement ratio no greater than 0.62 by weight. Sand must meet the requirements of the fine aggregate specified herein, except 100 percent must pass through a No. 8 sieve.

2.2.2 Dowels, Tie Bars, and Reinforcement

Provide dowels, tie bars, and reinforcement as indicated on the drawings.

PART 3 EXECUTION

3.1 PREPARATION OF EXISTING PAVEMENT

3.1.1 Preparation of Existing Surfaces

In the area to be patched, except popouts, remove existing concrete to a minimum depth of _3 inches below the pavement surface adjacent to spalls and to such additional depth where necessary to expose a surface of sound, unweathered concrete that is uncontaminated by sealants, oils, greases, or deicing salts or solutions. Make a vertical saw cut at least 3 inches deep and 3 inches outside of the area needing repair. The minimum area to be removed shall be 12" x 12" Accomplish concrete removal in spalled areas with light, hand-held, high-frequency chipping hammers weighing not more than 30 pounds or other approved hand tools. Do not use jack hammers weighing more than 30 pounds and do not use pavement breaker devices mounted on or pulled by mobile equipment.

Clean the cavity surface by waterblasting, blowing with compressed air, sweeping, and vacuums. Use waterblasting to remove all traces of sealer, oils, grease, rust, and other contaminants.

3.1.2 Dowels, Tie Bars, and Reinforcement

Cut and remove to minimum dimensions indicated existing dowels and tie bars exposed in joints adjacent to the spall cavity. Perform cutting by saws or other approved means; do not allow other cutting methods to damage concrete to remain. Clean to bare metal by sandblasting any existing reinforcement or dowels remaining exposed in the repair area. Remove any reinforcement that cannot be properly re-embedded in the new repair concrete. Cut and remove at the joint not less than 1/2 inch of existing exposed reinforcement that is continuous through the repair area and is embedded in the adjacent slab.

3.1.3 Preparation of Joints Adjacent to Spalls

Remove existing joint sealing and joint filler materials. Saw as indicated and install insert, cut to appropriate dimensions, to prevent contact between new patch material and existing concrete at existing joints. At the option of the Contractor, a bead of approved caulking material may be installed to preclude new patching material from getting around insert. Clean up any caulking material accidentally deposited on the prepared spall surface.

3.1.4 Disposal of Debris

Sweep from pavement surface to remove excess joint material, dirt, water, sand, and other debris by vacuum sweepers or hand brooms. Remove the debris immediately in accordance with Section 02 41 00 DEMOLITION.

3.1.5 Bonding Coat

Prior to placing concrete, wash the previously prepared surfaces with a high pressure water jet followed by an air jet to remove free water.

3.1.5.1 Neat Cement Grout

Coat the clean and dry surface, including sawed faces, with an approximate 1/16 inch thick coat of neat cement grout. Place the grout just prior to concrete placement and scrub with stiff bristle brushes to fill all voids and crevices in the spall cavity surface. Apply additional brush coats as needed to obtain the required thickness. The concrete patch material must be placed before the grout dries or sets. Remove dried or hardened grout by sandblasting and re-coat the cavity with fresh grout before placing concrete patch material.

3.1.5.2 Epoxy-Resin

Limit epoxy-resin bonding coat to use on patches with a surface area of less than 2 feet square. Coat the clean and dry surface, including sawed faces, with a 20 to 40 mil thick film of the epoxy-resin grout. Place the epoxy-resin grout in one application, just prior to concrete placement, with the use of mechanical combination, mixing and spraying equipment, or two coat application with stiff brushes. Scrub the first brush coat into the concrete surface, followed by an additional brush coat to obtain the required thickness. When the brush method is used, the initial coat may be allowed to dry; however, apply the final coat just prior to placement of the concrete.

3.1.5.3 Proprietary Cementitious Products

Apply in accordance with the manufacturer's written instructions.

Test as prescribed in the referenced specification under which it is furnished. Cement may be accepted on the basis of mill tests and the manufacturer's certification of compliance with the specification, provided the cement is the product of a mill with a record for the production of high-quality cement for the past 3 years.

3.1.6 Popout Repair

Popouts, as used herein, are pavement surface defects caused by deterioration of unsatisfactory coarse aggregate, decaying of organic material such as wood or roots, mechanical accidents, or other reasons. Most popouts are indicated on the drawings by average diameter but the actual surface configuration will vary from circular to polygonal. Repair popouts as indicated using sand-cement mortar for small popouts (less than 2 inches in width or depth) and portland cement concrete for large popouts. Clean popout cavities of all dirt and contaminants prior to filling. As indicated on drawings, prepare popout areas by chipping the concrete to eliminate feather edging of the mortar or concrete repair material. After preparing large popout cavities, coat with sand-cement grout bonding course immediately prior to filling with concrete.

3.1.7 Patch Material Selection

Fill the prepared cavity with: Portland cement concrete or latex modified concrete for cavities more than 600 cubic inches in volume after removal operations; portland cement mortar for cavities between 50 and 600 cubic inches; and epoxy resin mortar or latex modified mortar for those cavities less than 50 cubic inches in size. Proprietary cementitious patching materials may be used, subject to approval by the Contracting Officer.

3.2 BATCHING, MIXING AND PROPORTIONING

Provide facilities for the accurate measurement and control of each of the materials entering the concrete, mortar, or grout. Provide free access for the Contracting Officer to the batching and mixing plant at all times. Provide mixing equipment capable of combining the aggregate, cement, admixture, and water into a uniform mixture and discharging this mixture without segregation.

The use of volumetric batching and continuous mixing is acceptable, provided all operations are in accordance with ASTM C685/C685M.

3.2.1 Equipment

Assemble dependable and operable equipment, allowing time for thorough inspection, calibration of weighing and measuring devices, adjustment of parts, and the making of any repairs that may be required prior to final approval and the commencement of work. Maintain the equipment in good working condition.

3.2.2 Conveying

Convey concrete from mixer to repair area as rapidly as practicable by methods which prevent segregation or loss of ingredients.

3.2.3 Facilities for Sampling

Provide facilities for readily obtaining representative samples of aggregate and concrete for test purposes. Furnish necessary platforms, tools, and equipment for obtaining samples.

3.2.4 Mix Proportions

Use proportions of materials entering into the concrete mixture in accordance with the approved mix design. Revise the mix design whenever necessary to maintain the workability, strength, and standard of quality required, and to meet the varying conditions encountered during the construction; however, no changes shall be made without prior approval.

3.2.5 Measurement

Provide equipment necessary to measure and control the amount of each material in each batch of concrete. Weigh bulk cement. Cement in unopened bags as packed by the manufacturer may be used without weighing. One bag of portland cement is considered as weighing 94 pounds. Measure mixing water and air-entraining admixtures by volume or by weight. Consider one gallon of water as weighing 8.33 pounds.

3.2.6 Workability

Maintain the slump of the concrete at the lowest practicable value, not exceeding the specified value.

3.3 PLACING

3.3.1 Portland Cement Concrete

Place concrete within 90 minutes after the introduction of the mixing water to the cement and aggregate or the introduction of the cement to the aggregate, and before the concrete has obtained its initial set, and before the sand-cement grout bonding course has dried or obtained its initial set. The temperature of the concrete, as deposited in the repair area, must be not less than 50 degrees F nor more than 90 degrees F. Deposit concrete as to require a minimum of re-handling and in such a manner so as to least disturb the sand-cement grout. Place concrete as indicated to maintain existing joints ; do not allow new repair material to infiltrate or span existing joints indicated to remain. Place concrete continuously in each spall area. Do not allow workmen to walk on the bonding course surface or in the concrete during placing and finishing operations.

Consolidate the concrete by small spud vibrators not greater than one inch in diameter, except that repair areas less than 4 inches deep or one square foot in area may be consolidated by hand tamping or other approved means. To avoid pulling material away from patch edge and to maximize bond strength, work the finishing screed from the center of the patch out to the patch boundary. Fill all saw kerfs extending beyond the repair area with grout. Start finishing operations immediately after placement of the concrete. Match finished surface grade of patched areas to the existing surface grade of the adjacent undisturbed pavement. Keep screeding, floating, or toweling of patch material onto adjacent pavements to a minimum; remove loose or poorly bonded patch material from adjacent surfaces. Before the concrete becomes non-plastic, finish the surface with a broom to approximately match the surface finish of existing adjacent concrete pavement.

3.3.2 Epoxy-Resin Concrete and Mortar

Limit epoxy-resin bonding coat to use on patches with a surface area of less than 2 feet square. Place the epoxy resin materials in layers not over 2 inches thick. Make the time interval between placement of additional layers such that the temperature of the epoxy resin material does not exceed 140 degrees F at any time during hardening. Use mechanical vibrators and hand tampers to consolidate the concrete or mortar. Remove any repair material on the surrounding surfaces of the existing concrete before it hardens. Use an insert or other bond-breaking medium where the spalled area abuts a joint, to prevent bond at the joint face. Saw a reservoir for the joint sealant to the dimensions required for other joints. Thoroughly clean and seal the reservoir with the sealer specified for the joints.

3.3.3 Proprietary Cementitious Products

Perform placing, consolidating, finishing, and curing operations in accordance with the manufacturer's written instructions.

3.3.4 Joints

Construct new joints as detailed on the drawings and align with existing joints. After curing of the concrete, seal new joints as indicated and specified.

3.4 FIELD QUALITY CONTROL

3.4.1 General Requirements

Furnish concrete samples, taken in the field and tested to determine the slump, air content, and strength of the concrete. Make test cylinders for determining conformance with the strength requirements of these specifications and, when required, for determining the time at which pavements may be placed in service. Determine air content in conformance with ASTM C231/C231M. Mold and cure test cylinders in conformance with ASTM C31/C31M and as specified below. Furnish all materials, labor, and facilities required for molding, curing, and protecting test cylinders at the site and under the supervision of the Contracting Officer. Include furnishing and operating water tanks in curing facilities for test beams, equipped with temperature-control devices that will automatically maintain the temperature of the water at 73 degrees F plus or minus 5 degrees F. Also furnish and maintain at the site, boxes or other facilities suitable for storing the specimens while in the mold at a temperature of 73 degrees F plus or minus 10 degrees F. Tests of the fresh concrete and of the hardened concrete cylinders are to be made by and at the expense of the Contractor. Test Proprietary Cementitious Products in accordance with the manufacturer's written instructions.

3.4.2 Specimens for Strength Tests

Sample concrete in the field and test to determine the slump, air content, and strength of the concrete. Make cylinders for each shift of placed concrete. Mold each group of test cylinders from the same batch of concrete, consisting of a sufficient number of specimens to provide two compressive-strength tests at each test age. Make one group of specimens during the first half of each shift, and the other during the last portion of the shift. However, at the start of paving operations and each time the aggregate source, aggregate characteristics, or mix design is changed, make one additional set of test cylinders.

Determine the air content and slump in conformance with ASTM C173/C173M and ASTM C143/C143M, respectively. Mold and cure test cylinders in conformance with ASTM C31/C31M. Furnish and maintain at the site, boxes or other facilities suitable for storing the specimens while in the mold at a temperature of 73 degrees F plus or minus 10 degrees F. Test cylinders in accordance with ASTM C39/C39M.

3.4.2.1 Test Results

Remove concrete not meeting strength, consistency, and air content requirements and provide new acceptable concrete. The removal and replacement method or methods are subject to approval of the Contracting Officer.

3.4.2.2 Acceptance

Reject any spall repair material that cracks, or delaminates, or loses bond partly or completely, or causes spalling of adjacent portland cement

concrete, or is not separated properly from adjacent slabs at joints, or fails to cure uniformly and completely, or is otherwise defective. Remove all unacceptable repairs, including new damaged areas adjacent to new spall patches, and provide new repairs meeting the specifications.

3.5 FINISHING

Start finishing operations immediately after placement of the concrete. Finished surfaces of patched areas are to approximate surface texture of the adjacent undisturbed pavements.

3.6 CURING

Cure the concrete by protection against loss of moisture and rapid temperature changes for a period of not less than __7___ days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. Provide all equipment needed for adequate curing and protection of the concrete on hand and ready to install before actual concrete placement begins. Cure proprietary cementitious products in accordance with manufacturer's recommendations. Failure to comply with curing requirements will be cause for immediate suspension of concreting operations.

3.6.1 Moist Curing

Moist-cure all portland cement concrete patches for the first 24-hours after finishing. Immediately after the finishing operations are complete and the concrete is set sufficiently to prevent marring the surface, cover the entire surface of the newly laid concrete with approved wetted burlap, and keep wet for a period of not less than 24 hours. Keep the surface of the newly laid concrete moist until the burlap coverings are in place. Ensure that moist curing is continuous 24 hours per day and that the entire surface is wet, by having an approved work system. Continue curing the concrete for the duration of the required curing period by this method or one of the methods specified below.

3.6.2 Waterproof-Paper Blankets or Impermeable Sheets

Immediately after removing the covering used for initial curing, moisten the exposed concrete surfaces with a fine spray of water and cover with waterproof-paper blankets, polyethylene-coated-burlap blankets, or impermeable sheets. Saturate polyethylene-coated burlap with water before placing. Place sheets with the light-colored side up. Overlap sheets not less than 12 inches with edges taped or secured to form a completely closed joint. Weight down coverings to prevent displacement or billowing from winds. Immediately repair tears or holes appearing during the curing by patching.

3.6.3 Membrane-Forming Curing Compound

Apply membrane -forming curing compound immediately to exposed concrete surfaces after removing burlap coverings. Apply the curing compound with an overlapping coverage that will give a two-coat application at a coverage of not more than 200 square feet per gallon for both coats. When application is made by hand-operated sprayers, apply the second coat in a direction approximately at right angles to the first coat.

Cure concrete properly at joints, but do not allow absorbent curing compound to enter joints that are to be sealed with joint-sealing

compounds. Provide a uniform, continuous, cohesive compound film that will not check, crack, or peel, and that will be free from pinholes and other imperfections. Respray concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied at the coverage specified above and at no additional cost to the Government. Respray areas covered with absorbent curing material that are damaged by pedestrian and vehicular traffic or by subsequent construction operations within the specified curing period at no additional cost to the Government.

3.7 FINISH TOLERANCE

Provide finished surfaces of patched areas meeting the grade of the adjoining pavements without deviations more than 1/8 inch from a true plan surface within the patched area.

3.8 PAVEMENT PROTECTION

Protect the patched areas against damage prior to final acceptance of the work by the Government. Exclude traffic from the patched areas by erecting and maintaining barricades and signs until the completion of the curing period of the concrete.

3.9 JOINTS

Provide joints conforming in detail and in alignment with the existing joints. After curing of the concrete, prepare and seal the joints in accordance with Section 32 01 19.61 RESEALING OF JOINTS IN RIGID PAVEMENTS.

-- End of Section --

SECTION 32 11 23

AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE
08/08

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 basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131/C131M	(2014) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C29/C29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C88	(2013) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4318	(2010; E 2014) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D5821	(2013) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates
ASTM E11	(2013) Wire Cloth and Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Graded-Crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.2.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve are expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools
Waybills and Delivery Tickets

SD-06 Test Reports

Sampling and Testing; G
Field Density Tests; G

1.4 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor and performed by a testing laboratory approved in accordance with Section 01 45 00.00 10 01 45 00.00 2001 45 00.00 40 QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements; perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.4.1 Sampling

Take samples for laboratory testing in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

Perform the following tests in conformance with the applicable standards listed.

1.4.2.1 Sieve Analysis

Make sieve analysis in conformance with ASTM C117 and ASTM C136/C136M. Sieves shall conform to ASTM E11.

1.4.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D4318.

1.4.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with ASTM D1557.

1.4.2.4 Field Density Tests

Measure field density in accordance with ASTM D1556, ASTM D2167 or ASTM D6938. For the method presented in ASTM D1556 use the base plate as shown in the drawing. For the method presented in ASTM D6938 check the

calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D6938 result in a wet unit weight of soil, and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D6938. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D6938, on each different type of material being tested at the beginning of a job and at intervals as directed.

a. Submit certified copies of test results for approval not less than 30 days before material is required for the work.

b. Submit calibration curves and related test results prior to using the device or equipment being calibrated.

c. Submit copies of field test results within 24hours after the tests are performed.

1.4.2.5 Wear Test

Perform wear tests on GCA course material in conformance with ASTM C131/C131M.

1.4.2.6 Soundness

Perform soundness tests on GCA in accordance with ASTM C88.

1.4.2.7 Weight of Slag

Determine weight per cubic foot of slag in accordance with ASTM C29/C29M on the GCA course material.

1.4.3 Testing Frequency

1.4.3.1 Initial Tests

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

a. Sieve Analysis including the No. 635 sieve.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

e. Soundness.

f. Weight per cubic foot of Slag.

1.4.3.2 In Place Tests

Perform each of the following tests on samples taken from the placed and

compacted GCA. Samples shall be taken and tested at the rates indicated.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 250 square yard, or portion thereof, of completed area.

b. Perform sieve analysis including the No. 635 sieve on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.

d. Measure the total thickness of the base course at intervals, in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

1.4.4 Approval of Material

Select the source of the material 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted course(s).

1.5 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Provide adequate equipment having the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

2.2 AGGREGATES

Provide GCA consisting of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, angular sand, or other approved material. GCA shall be free of silt and clay as defined by ASTM D2487, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve is known as coarse aggregate; that portion passing the No. 4 sieve is known as fine aggregate.

2.2.1 Coarse Aggregate

Provide coarse aggregates with angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled

separately.

a. Crushed Gravel: Crushed gravel manufactured by crushing gravels, and meets all the requirements specified below.

b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.

c. Crushed Recycled Concrete: Provide crushed recycled concrete consisting of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Reject recycled concrete aggregate exceeding this value. Crushed recycled concrete must meet all other applicable requirements specified below.

d. Crushed Slag: Crushed slag is an air-cooled blast-furnace product having an air dry unit weight of not less than 70 pcf as determined by ASTM C29/C29M, and meets all the requirements specified below.

2.2.1.1 Graded-Crushed Aggregate Base Course

GCA coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C131/C131M. GCA coarse aggregate shall not exhibit a loss greater than 18 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate, or 12 percent weighted average, at five cycles, when tested in sodium sulfate in accordance with ASTM C88. The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the 1/2 inch sieve nor 20 percent for the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces determined in accordance with ASTM D5821. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

2.2.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.2.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.2.2.2 Graded-Crushed Aggregate Base Course

Provide GCA fine aggregate consisting of angular particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. Fine aggregate shall be

produced by crushing only particles larger than No. 4 sieve in size. The fine aggregate shall contain at least 90 percent by weight of particles having two or more freshly fractured faces in the portion passing the No. 4 sieve and retained on the No. 10 sieve, and in the portion passing the No. 10 sieve and retained on the No. 40 sieve.

2.2.3 Gradation Requirements

Apply the specified gradation requirements to the completed base course. The aggregates shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E11.

TABLE 1. GRADATION OF AGGREGATES			
Percentage by Weight Passing Square-Mesh Sieve			
Sieve Designation	No. 1	No. 2	No. 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	0-8	0-8	0-8
NOTE 1: Particles having diameters less than No. 635 shall not be in excess of 3 percent by weight of the total sample tested.			
NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C127 and ASTM C128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.			

2.3 LIQUID LIMIT AND PLASTICITY INDEX

Apply liquid limit and plasticity index requirements to the completed course and to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the GCA is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area. Provide line and grade stakes as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating are the responsibility of the Contractor. Operate the aggregate sources to produce the quantity and quality of materials meeting the specified requirements in the specified time limit. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.3 STOCKPILING MATERIAL

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the base course(s), the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the base course(s), the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 31 00 00 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the base course(s). Stabilization shall be accomplished by mixing GCA into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the base course is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

Mix the coarse and fine aggregates in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. Make adjustments in mixing procedures or in equipment, as directed, to obtain true grades,

to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification.

3.5.2 Placing

Place the mixed material on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, place the material in a single layer. When a compacted layer in excess of 6 inches is required, place the material in layers of equal thickness. No layer shall be thicker than 6 inches or thinner than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.5.3 Grade Control

The finished and completed base course shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required base course thickness so that the finished base course and the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The base course(s) shall be placed so that the completed section will be a minimum of 2 feet wider, on all sides, than the next layer that will be placed above it. Additionally, place approved fill material along the outer edges of the base course in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of base course. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Compact each layer of the base course, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Continue compaction until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. Make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase

water content, and to ensure a satisfactory base course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Construct the compacted thickness of the base course as indicated. No individual layer shall be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. The total compacted thickness of the base course(s) shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.5.7 Proof Rolling

Proof rolling of the areas indicated shall be in addition to the compaction specified In areas designated, apply proof rolling to the top of the underlying material on which the base course is laid and to each layer of base course. Maintain water content of the underlying material at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the base course shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any base course materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and proof rolled to meet these specifications.

3.5.8 Finishing

The surface of the top layer of base course shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of base course is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material

and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

Do not allow traffic on the completed base course.

3.7 MAINTENANCE

Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Dispose of any unsuitable materials that must be removed as directed. No additional payments will be made for materials that must be replaced.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 32 12 10

BITUMINOUS TACK AND PRIME COATS
08/08

PART 1 GENERAL

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 102	(2009) Standard Method of Test for Spot Test of Asphaltic Materials
AASHTO T 40	(2002; R 2006) Sampling Bituminous Materials

ASTM INTERNATIONAL (ASTM)

ASTM D140/D140M	(2009) Standard Practice for Sampling Bituminous Materials
ASTM D2397	(2005) Standard Specification for Cationic Emulsified Asphalt
ASTM D2995	(1999; R 2009) Determining Application Rate of Bituminous Distributors
ASTM D977	(2013) Emulsified Asphalt

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

Plant, equipment, machines and tools used in the work are subject to approval and shall be maintained in a satisfactory working condition at all times. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, should have been recalibrated by a calibration laboratory within 6 months prior to commencing work and every 6 months thereafter, by such laboratory from the date of recalibration, during the term of the contract.

1.3.2 Bituminous Distributor

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 650 psi of tire width 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. Include with the distributor equipment 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.

1.3.3 Heating Equipment for Storage Tanks

The equipment for heating the bituminous material shall be steam, electric, or hot oil heaters. Provide steam heaters consisting 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.

1.3.4 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.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Sampling and Testing

1.6 DELIVERY, STORAGE, AND HANDLING

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling.

1.7 ENVIRONMENTAL REQUIREMENTS

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.

PART 2 PRODUCTS

2.1 PRIME COAT

2.1.2 Emulsified Asphalt

Provide emulsified asphalt conforming to ASTM D977, Type SS-1 or SS1h.

2.2 TACK COAT

2.2.2 Emulsified Asphalt

Provide emulsified asphalt conforming to ASTM D977, Type SS-1 or SS1h ASTM D2397. 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 0.18 gallon nor more than 0.35 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:

Emulsions	
SS-1	70-160 degrees F
SS-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

Apply a prime coat to any granular base material exposed after cold milling operations. 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 opts 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; the rate shall be as specified above in paragraph APPLICATION RATE. 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 tack coat to all cold milled surfaces and interfaces between newly placed asphalt lifts. 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 as specified above in paragraph APPLICATION RATE. 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, allow the bituminous coat 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 FIELD QUALITY CONTROL

Samples of the bituminous material shall be tested for compliance with the applicable specified requirements. A sample shall be obtained and tested by the Contractor for every 5000 gallons of bituminous material used.

3.7 SAMPLING AND TESTING

Submit copies of all test results for emulsified asphalt, and bituminous materials, within 24 hours of completion of tests. Furnish 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. Perform sampling and testing by an approved commercial testing laboratory.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D140/D140M or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

Furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibrate the bituminous distributor in accordance with ASTM D2995.

3.7.3 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.

3.7.3.1 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.

3.7.3.2 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.

3.7.4 Sampling and Testing During Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL.

3.8 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 12 15.13

HOT-MIX ASPHALT AIRFIELD PAVING
11/12

PART 1 GENERAL

1.1 FULL PAYMENT

1.1.1 Method of Measurement

Measurement of the quantity of hot-mix asphalt, per ton placed and accepted, shall be made for the purposes of assessing the pay factors stipulated below.

1.1.2 Basis of Payment

The measured quantity of hot-mixed asphalt will be paid for and included in the lump-sum contract price. If less than 100 percent payment is due based on the pay factors stipulated in paragraph QUALITY ASSURANCE, a unit price of $170.00 per ton will be used for purposes of calculating the payment reduction.

1.2 PERCENT PAYMENT

When a lot of material fails to meet the specification requirements for 100 percent pay as outlined in the following paragraphs, that lot shall be removed and replaced, or accepted at a reduced price which will be computed by multiplying the unit price by the lot's pay factor. The lot pay factor is determined by taking the lowest computed pay factor based on either laboratory air voids, in-place density, grade or smoothness (each discussed below). Pay factors based on different criteria (i.e., laboratory air voids and in-place density) of the same lot will not be multiplied together to get a lower lot pay factor. At the end of the project, an average of all lot pay factors will be calculated. If this average lot pay factor exceeds 95.0 percent and no individual lot has a pay factor less than 75.1 percent, then the percent payment for the entire project will be 100 percent of the unit bid price. If the average lot pay factor is less than 95.0 percent, then each lot will be paid for at the unit price multiplied by the lot's pay factor. For any lots which are less than 2000 short tons, a weighted lot pay factor will be used to calculate the average lot pay factor.

1.2.1 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage of the average theoretical maximum density (TMD) for the lot. The average TMD for each lot will be determined as the average TMD of the two random samples per lot. The average in-place mat density and joint density for a lot are determined and compared with Table 1 to calculate a single pay factor per lot based on in-place density, as described below. First, a pay factor for both mat density and joint density are determined from Table 1. The area associated with the joint is then determined and will be considered to be 10 feet wide times the length of completed longitudinal construction joint in the lot. This area will not exceed the total lot size. The length of joint to be considered will be that length where a new lane has been placed against an adjacent lane of hot-mix asphalt pavement,

either an adjacent freshly paved lane or one paved at any time previously. The area associated with the joint is expressed as a percentage of the total lot area. A weighted pay factor for the joint is determined based on this percentage (see example below). The pay factor for mat density and the weighted pay factor for joint density is compared and the lowest selected. This selected pay factor is the pay factor based on density for the lot. When the TMD on both sides of a longitudinal joint is different, the average of these two TMD will be used as the TMD needed to calculate the percent joint density. Rejected lots shall be removed and replaced. Rejected areas adjacent to longitudinal joints shall be removed 4 inches into the cold (existing) lane. All density results for a lot will be completed and reported within 24 hours after the construction of that lot.

Table 1. Pay Factor Based on In-place Density

Average Mat Density (4 cores)	Pay Factor, percent	Average Joint Density (4 cores)
94.0 - 96.0	100.0	Above 92.5
93.9	100.0	92.4
93.8 or 96.1	99.9	92.3
93.7	99.8	92.2
93.6 or 96.2	99.6	92.1
93.5	99.4	92.0
93.4 or 96.3	99.1	91.9
93.3	98.7	91.8
93.2 or 96.4	98.3	91.7
93.1	97.8	91.6
93.0 or 96.5	97.3	91.5
92.9	96.3	91.4
92.8 or 96.6	94.1	91.3
92.7	92.2	91.2
92.6 or 96.7	90.3	91.1
92.5	87.9	91.0
92.4 or 96.8	85.7	90.9
92.3	83.3	90.8
92.2 or 96.9	80.6	90.7

Table 1. Pay Factor Based on In-place Density		
Average Mat Density (4 cores)	Pay Factor, percent	Average Joint Density (4 cores)
92.1	78.0	90.6
92.0 or 97.0	75.0	90.5
below 92.0, above 97.0	0.0 (reject)	below 90.5

1.2.2 Pay Factor Based on In-place Density

An example of the computation of a pay factor (in I-P units only) based on in-place density, is as follows: Assume the following test results for field density made on the lot: (1) Average mat density = 93.2 percent (of lab TMD). (2) Average joint density = 91.5 percent (of lab TMD). (3) Total area of lot = 30,000 square feet. (4) Length of completed longitudinal construction joint = 2000 feet.

a. Step 1: Determine pay factor based on mat density and on joint density, using Table 1:

Mat density of 93.2 percent = 98.3 pay factor.

Joint density of 91.5 percent = 97.3 pay factor.

b. Step 2: Determine ratio of joint area (length of longitudinal joint x 10 ft) to mat area (total paved area in the lot): Multiply the length of completed longitudinal construction joint by the specified 10 ft. width and divide by the mat area (total paved area in the lot).

(2000 ft. x 10 ft.)/30000 sq.ft. = 0.6667 ratio of joint area to mat area (ratio).

c. Step 3: Weighted pay factor (wpf) for joint is determined as indicated below:

wpf = joint pay factor + (100 - joint pay factor) (1 - ratio) wpf = 97.3 + (100-97.3) (1-.6667) = 98.2 percent

d. Step 4: Compare weighted pay factor for joint density to pay factor for mat density and select the smaller:

Pay factor for mat density: 98.3 percent. Weighted pay factor for joint density: 98.2 percent

Select the smaller of the two values as pay factor based on density: 98.2 percent

1.2.3 Payment Adjustment for Smoothness

a. Straightedge Testing. Location and deviation from straightedge for all measurements shall be recorded. When between 5.0 and 10.0 percent of all measurements made within a lot exceed the tolerance specified in paragraph Smoothness Requirements below, after any reduction of high spots or removal and replacement, the computed pay factor for that lot based on surface smoothness, will be 95 percent. When more than 10.0

percent of all measurements exceed the tolerance, the computed pay factor will be 90 percent. When between 15.0 and 20.0 percent of all measurements exceed the tolerance, the computed pay factor will be 75 percent. When 20.0 percent or more of the measurements exceed the tolerance, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 50 percent, shall be corrected by diamond grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

b. Profilograph Testing. Location and data from all profilograph measurements shall be recorded. When the Profile Index of a lot exceeds the tolerance specified in paragraph Smoothness Requirements by 1.0 inch/mile, but less than 2.0 inches/mile, after any reduction of high spots or removal and replacement, the computed pay factor for that lot based on surface smoothness will be 95 percent. When the Profile Index exceeds the tolerance by 2.0 inches/mile, but less than 3.0 inches/mile, the computed pay factor will be 90 percent. When the Profile Index exceeds the tolerance by 3.0 inches/mile, but less than 4.0 inches/mile, the computed pay factor will be 75 percent. When the Profile Index exceeds the tolerance by 4.0 inches/mile or more, the lot shall be removed and replaced at no additional cost to the . Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 5.0 inches/mile or more, shall be corrected by grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

1.2.4 Laboratory Air Voids and Theoretical Maximum Density

Laboratory air voids will be calculated in accordance with ASTM D3203/D3203M by determining the Marshall density of each lab compacted specimen using the laboratory-prepared, thoroughly dry method in ASTM D2726 and determining the theoretical maximum density (TMD) of two of the sublots using ASTM D2041/D2041M. Laboratory air void calculations for each lot will use the average theoretical maximum density values obtained for the lot. The mean absolute deviation of the four laboratory air void contents (one from each sublot) from the JMF air void content will be evaluated and a pay factor determined from Table 2. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot. The TMD is also used for computation of compaction, as required in paragraph: Mat and Joint Densities above.

1.2.5 Mean Absolute Deviation

An example of the computation of mean absolute deviation for laboratory air voids is as follows: Assume that the laboratory air voids are determined from 4 random samples of a lot (where 3 specimens were compacted from each sample). The average laboratory air voids for each sublot sample are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

Mean Absolute Deviation = $(|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4$

$= (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45$

The mean absolute deviation for laboratory air voids is determined to be

0.45. It can be seen from Table 2 that the lot's pay factor based on laboratory air voids, is 100 percent.

Table 2. Pay Factor Based on Laboratory Air Voids	
Mean Absolute Deviation of Lab Air Voids from JMF	Pay Factor, Percent
0.60 or less	100
0.61 - 0.80	98
0.81 - 1.00	95
1.01 - 1.20	90
Above 1.20	reject (0)

1.2.6 Pay Adjustment Based on Grade

Within 5 working days after completion of a particular lot incorporating the final wearing course, test the final wearing surface of the pavement for conformance with specified plan grade requirements. All testing shall be performed in the presence of the Contracting Officer. The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.03 foot for runways or 0.05 foot for taxiways and aprons from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. When more than 5 percent of all measurements made within a lot are outside the 0.03 or 0.05 foot tolerance, the pay factor based on grade for that lot will be 95 percent. In areas where the grade exceeds the tolerance by more than 50 percent, remove the surface lift full depth; and replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or plaining or milling for correcting high areas will not be permitted.

1.3 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 156 (1997: R 2009) Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving

	Mixtures
AASHTO M 320	(2010) Standard Specification for Performance-Graded Asphalt Binder
AASHTO T 308	(2010) Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 329	(2008) Standard Test Method for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

ASPHALT INSTITUTE (AI)

AI MS-2	(1997 6th Ed) Mix Design Methods

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C1252	(2006) Standard Test Methods for Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM C127	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C142/C142M	(2010) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C29/C29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C566	(2013) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C88	(2013) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM D140/D140M	(2009) Standard Practice for Sampling Bituminous Materials
ASTM D1461	(2011) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D2041/D2041M	(2011) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172/D2172M	(2011) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D2419	(2014) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D242/D242M	(2009) Mineral Filler for Bituminous Paving Mixtures
ASTM D2489/D2489M	(2008) Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	(2011) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D3203/D3203M	(2011) Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D3665	(2012) Random Sampling of Construction Materials
ASTM D3666	(2011) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4125/D4125M	(2010) Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D4791	(2010) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867/D4867M	(2009) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5444	(2008) Mechanical Size Analysis of Extracted Aggregate
ASTM D6307	(2010) Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D6926	(2010) Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D979/D979M	(2012) Sampling Bituminous Paving Mixtures

ASTM E1274 (2003; R 2012) Standard Test Method for Measuring Pavement Roughness Using a Profilograph

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 171 (1995) Standard Test Method for Determining Percentage of Crushed Particles in Aggregate

1.4 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. Hot-mix asphalt (HMA) designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Construct each course to the depth, section, or elevation required by the drawings and rolled, finished, and approved before the placement of the next course. Submit proposed Placement Plan, indicating lane widths, longitudinal joints, and transverse joints for each course or lift.

1.4.1 Asphalt Mixing Plant

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of AASHTO M 156 with the following changes:

a. Truck Scales. Weigh the asphalt mixture on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. Provide laboratory facilities at the plant for the use of the Contractor's quality control testing.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. Provide assistance as requested, for the government to procure any desired samples.

d. Storage Bins. The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours. The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.4.2 Hauling Equipment

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.4.3 Material Transfer Vehicle (MTV)

Material transfer Vehicles shall be required due to the improvement in smoothness and decrease in both physical and thermal segregation. To transfer the material from the hauling equipment to the paver, use a self-propelled, material transfer vehicle with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.

1.4.4 Asphalt Pavers

Mechanical spreading and finishing equipment shall consist of a self-powered paver, capable of spreading and finishing the mixture to the specified line, grade, and cross section. The screed of the paver shall be capable of laying a uniform mixture to meet the specified thickness, smoothness, and grade without physical or temperature segregation, the full width of the material being placed. The screed will be equipped with a compaction device and it will be used during all placement.

1.4.4.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.4.4.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet in length.

b. Taut stringline set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.4.5 Rollers

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of

rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. 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

Placement Plan; G

SD-03 Product Data

Mix Design; G
Contractor Quality Control; G

SD-04 Samples

Asphalt Cement Binder
Aggregates

SD-06 Test Reports

Aggregates; G
QC Monitoring

SD-07 Certificates

Asphalt Cement Binder; G
Testing Laboratory

1.6 QUALITY ASSURANCE

Testing for acceptability of work will be performed by the Contractor or by an independent laboratory hired by the Contractor. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 2000 short tons. Where appropriate, adjustment in payment for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

1.6.1 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness

conforming to ASTM D3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with ASTM D6926. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

1.6.2 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be treated as a separate lot. Payment will be made for the quantity of HMA represented by these tests in accordance with the provisions of this section.

1.6.3 In-place Density

For determining in-place density, one random core (4 inches or 6 inches in diameter) will be taken at locations identified by the Government from the mat (interior of the lane) of each sublot, and one random core will be taken from the joint (immediately over joint) of each sublot, in accordance with ASTM D979/D979M. Fill all core holes with hot-mix. The core holes shall be dry and tack coated before filling. Each random core will be full thickness of the layer being placed. When the random core is less than 1 inch thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying to meet the requirements for laboratory-prepared, thoroughly dry specimens, cores obtained from the mat and from the joints will be used for in-place density determination in accordance with ASTM D2726.

1.6.4 Surface Smoothness

Use the following methods to test and evaluate surface smoothness of the finished surface of the pavement final grade. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. The profilograph method shall be used for all longitudinal and transverse testing, except where the runs would be less than 200 feet in length and the ends where the straightedge shall be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

1.6.4.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified in Table 3 when checked with an approved 12 foot straightedge.

Table 3. Straightedge Surface Smoothness--Pavements		
Pavement Category	Direction of Testing	Tolerance, inches
Runways and taxiway	Longitudinal	1/8
	Transverse	1/4
Shoulders (outside edge stripe)	Transverse	1/4
	Longitudinal	Not Required
Calibration hardstands and compass swinging bases	Longitudinal	1/8
	Transverse	1/8
All other airfields and helicopter paved areas	Longitudinal	1/4
	Transverse	1/4

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavement shall have a Profile Index not greater than specified in Table 4 when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 200 feet, that direction shall be tested by the straightedge method and shall meet requirements specified above.

Table 4. Profilograph Surface Smoothness--Pavements		
Pavement Category	Direction of Testing	Maximum Specified Profile Index (inch/mile)
Runways	Longitudinal	7
	Transverse	(Use Straightedge)
Taxiways	Longitudinal	9
	Transverse	(Use Straightedge)
Shoulders (outside edge stripe)	Transverse	(Use Straightedge)
	Longitudinal	Not Required
Calibration Hardstands and Compass Swinging Bases		(Use Straightedge)

Table 4. Profilograph Surface Smoothness--Pavements		
Pavement Category	Direction of Testing	Maximum Specified Profile Index (inch/mile)
All Other Airfield and Helicopter Paved Areas	Longitudinal	9
	Transverse	9

1.6.4.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are diamond ground, these areas shall be retested immediately after grinding. The area corrected by grinding shall not exceed 10 percent of the total area of the lot. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 20 feet and at the third points for lanes 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Profilograph Testing. Profilograph testing shall be performed using an approved California profilograph and procedures described in ASTM E1274. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.4 inch. The profilograph shall be operated by an approved, factory-trained operator on the alignments specified above. A copy of the reduced tapes shall be furnished to the Government at the end of each day's testing.

c. Bumps ("Must Grind" Areas). Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height shall be reduced by diamond grinding until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas. At the Contractor's option, pavement areas, including ground areas, may be rechecked with the profilograph in order to record a lower Profile Index.

1.7 ENVIRONMENTAL REQUIREMENTS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 5. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 5. Surface Temperature Limitations of Underlying Course

Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. Submit sufficient materials to produce 200 lb of blended mixture for mix design verification. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction. Aggregate testing shall have been performed within 90 days of performing the mix design.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. The coarse aggregate particles shall meet the following requirements:

a. The percentage of loss shall not be greater than 40 percent after 500 revolutions when tested in accordance with ASTM C131.

b. The sodium sulfate soundness loss shall not exceed 12 percent, or the magnesium sulfate soundness loss shall not exceed 18 percent after five cycles when tested in accordance with ASTM C88.

c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with COE CRD-C 171. Fractured faces shall be produced by crushing.

d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20 percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D4791.

e. Slag shall be air-cooled, blast furnace slag, and shall have a compacted weight of not less than 75 lb/cu ft when tested in accordance with ASTM C29/C29M.

f. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with ASTM C142/C142M.

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. The fine aggregate particles shall meet the following requirements:

a. The quantity of natural sand (noncrushed material) added to the aggregate blend shall not exceed 15 percent by weight of total aggregate.

b. The individual fine aggregate sources shall have a sand equivalent value greater than 45 when tested in accordance with ASTM D2419.

c. The fine aggregate portion of the blended aggregate shall have an uncompacted void content greater than 45.0 percent when tested in accordance with ASTM C1252 Method A.

d. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with ASTM C142/C142M.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D242/D242M.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 6, when tested in accordance with ASTM C136 and ASTM C117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine. The JMF shall be within the specification limits; however, the gradation can exceed the limits when the allowable deviation from the JMF shown in Tables 9 and 10 are applied.

Table 6. Aggregate Gradations

		Gradation 2 (intermediate and surface courses)	Gradation 3 (shoulders and leveling courses only)
Sieve Size, inch	Percent Passing by Mass	Percent Passing by Mass	Percent Passing by Mass
1		---	---
3/4		100	---
1/2		90-100	100
3/8		69-89	90-100

Table 6. Aggregate Gradations			
		Gradation 2 (intermediate and surface courses)	Gradation 3 (shoulders and leveling courses only)
Sieve Size, inch	Percent Passing by Mass	Percent Passing by Mass	Percent Passing by Mass
No. 4		53-73	58-78
No. 8		38-60	40-60
No. 16		26-48	28-48
No. 30		18-38	18-38
No. 50		11-27	11-27
No. 100		6-18	6-18
No. 200		3-6	3-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to AASHTO M 320 Performance Grade (PG) 67-22. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contractor may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained in accordance with ASTM D140/D140M and in the presence of the Contracting Officer.

2.3 MIX DESIGN

Develop the mix design. The Job Mix formula (JMF)shall have been developed and aggregates tested no earlier than 6 months before contract award. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of Table 6. No hot-mix asphalt for payment shall be produced until a JMF has been approved. Laboratory compaction temperatures for Polymer Modified Asphalts shall be as recommended by the asphalt cement manufacturer. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D4867/D4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided at no additional cost to the Government.

2.3.1 JMF Requirements

Submit the proposed JMF in writing, for approval, at least 14 days prior to the start of the test section, including as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade.

e. Number of Superpave gyratory compactor gyrations.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots and summary tabulation of air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2. Summary tabulation shall include individual specimen data for each specimen tested.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with two or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Tensile Strength Ratio and wet/dry specimen test results.

q. Antistrip agent (if required).

r. List of all modifiers.

s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of RAP in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 7. Superpave Gyratory Compaction Criteria

Test Property	Value
Air voids, percent	4(1)
Percent Voids in mineral aggregate (minimum)	See Table 8
Dust Proportion(2)	0.8-1.2
TSR, minimum percent	75

Table 7. Superpave Gyratory Compaction Criteria	
Test Property	Value
(1) Select the JMF asphalt content corresponding to an air void content of 4 percent. Verify the other properties of Table 7 meet th specification requirements at this asphalt content.	
(2) Dust Proportion is calculated as the aggregate content, expressed as a percent of mass, passing the No. 200 sieve, divided by the effective asphalt content, in percent of total mass of the mixture.	

Table 8. Minimum Percent Voids in Mineral Aggregate (VMA) (1)	
Aggregate (See Table 6)	Minimum VMA, percent
Gradation 1	14
Gradation 2	15
(1) Calculate VMA in accordance with AI MS-2, based on ASTM D2726 bulk specific gravity for the aggregate.	

2.3.2 Adjustments to JMF

The JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new mix design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to make minor adjustments within the specification limits to the JMF to optimize mix volumetric properties. Adjustments to the original JMF shall be limited to plus or minus 4 percent on the No. 4 and coarser sieves; plus or minus 3 percent on the No. 8 to No. 50 sieves; and plus or minus 1 percent on the No. 100 sieve. Adjustments to the JMF shall be limited to plus or minus 1.0 percent on the No. 200 sieve. Asphalt content adjustments shall be limited to plus or minus 0.40 from the original JMF. If adjustments are needed that exceed these limits, a new mix design shall be developed.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. RAP stockpiles shall be free from contamination, including coal-tar sealers. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. The individual aggregates in a RAP chunk shall not exceed the maximum size aggregate of the gradation specified in Table 6. The recycled HMA mix shall be designed using procedures contained in AI MS-2. The job mix shall meet the requirements of paragraph MIX DESIGN. RAP shall only be used for shoulder surface course mixes and for any intermediate courses. The amount of RAP shall be limited so the asphalt binder from the RAP does not exceed 30 percent of the total asphalt content.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D2172/D2172M using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the requirements in paragraph ASPHALT CEMENT BINDER. For PG graded asphalt binders adjust as follows:

a. For 0-20 percent recycled binder content - no change in virgin binder selection.

b. For 20+ to 30 percent recycled binder content - select virgin binder one grade softer than normal.

PART 3 EXECUTION

3.1 CONTRACTOR QUALITY CONTROL

3.1.1 General Quality Control Requirements

Submit the approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design and unique JMF identification code

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management and procedures to prevent contamination

e. Proportioning

f. Mixing and Transportation

h. Mixture Volumetrics

i. Moisture Content of Mixtures

j. Placing and Finishing

k. Joints

l. Compaction, including HMA-PCC joints

m. Surface Smoothness

n. Truck bed release agent

3.1.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job

site. It shall be equipped with heating and air conditioning units to maintain a temperature of 75 plus or minus 5 degrees F. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.1.3 Quality Control Testing

Perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.1.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph QUALITY ASSURANCE) by one of the following methods: extraction method in accordance with ASTM D2172/D2172M, Method A or B, the ignition method in accordance with the AASHTO T 308, ASTM D6307, or the nuclear method in accordance with ASTM D4125/D4125M, provided each method is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D2172/D2172M, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.1.3.2 Aggregate Properties

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D5444 or ASTM D6307. For batch plants, aggregates shall be tested in accordance with ASTM C136 using actual batch weights to determine the combined aggregate gradation of the mixture. The specific gravity of each aggregate size grouping shall be determined for each 20,000 tons in accordance with ASTM C127 or ASTM C128. Fractured faces for gravel sources shall be determined for each 20,000 tons in accordance with COE CRD-C 171. The uncompacted void content of manufactured sand shall be determined for each 20,000 tons in accordance with ASTM C1252 Method A.

3.1.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.1.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C566.

3.1.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with AASHTO T 329.

3.1.3.6 Laboratory Air Voids, VMA

Mixture samples shall be taken at least four times per lot and compacted into specimens, using 75 gyrations of the Superpave gyratory compactor as described in ASTM D6925. After compaction, the laboratory air voids and VMA of each specimen shall be determined. The VMA shall be within the limits of Table 8.

3.1.3.7 In-Place Density

Conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge or other non-destructive testing device may be used to monitor pavement density.

3.1.3.8 Grade and Smoothness

Conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph QUALITY ASSURANCE.

3.1.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.1.3.10 QC Monitoring

Submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.1.4 Sampling

When directed by the Contracting Officer, sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.1.5 Control Charts

For process control, establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 9, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 9 applicable to the test parameter being plotted, and the Contractor's test results. Target values (JMF) shall also

be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, halt production until the problem is solved. When the Suspension Limit is exceeded for individual values or running average values, the Contracting Officer Engineer has the option to require the Contractor to remove and replace the material represented by the samples or to leave in place and base acceptance on mixture volumetric properties and in place density. Use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 9. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Individual Samples		Running Average of Last Four Samples	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative Percent Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative Percent Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative Percent Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Asphalt content, percent deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3

Table 9. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Individual Samples		Running Average of Last Four Samples	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
Laboratory Air Voids, percent deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, percent of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, percent of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			
VMA				
Gradation 1	14.3	14.0	14.5	14.0
Gradation 2	15.3	15.0	15.0	15.0

3.2 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates.

3.3 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.4 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a thorough and uniform coating of asphalt binder (testing in accordance with ASTM D2489/D2489M may be required by the Contracting Officer) and is thoroughly distributed throughout the mixture. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D1461.

3.5 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall

be cleaned of dust and debris. A prime coat and/or tack coat shall be applied in accordance with the contract specifications.

3.6 TEST SECTION

Prior to full production, place a test section for each JMF used. Construct a test section consisting of a maximum of 250 tons and two paver passes wide placed in two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the .

3.6.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for theoretical maximum density (TMD), aggregate gradation and asphalt content. An additional portion of the sample shall be tested to determine the Tensile Strength Ratio (TSR). Adjust the compactive effort as required to provide TSR specimens with an air void content of 7 plus/minus 1 percent. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D3665. The test results shall be within the tolerances or exceed the minimum values shown in Table 10 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the and another test section shall be constructed.

Table 10. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	See Table 8
Tensile Strength Ratio (TSR) (At 7 percent plus/minus 1 percent air void content)	75 percent minimum

Table 10. Test Section Requirements for Material and Mixture Properties	
Property	Specification Limit
Conditioned Strength	60 psi minimum
Mat Density, Percent of TMD (Average of 4 Random Cores)	92.0 - 96.0
Joint Density, Percent of TMD (Average of 4 Random Cores)	90.5 minimum

3.6.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.7 TESTING LABORATORY

The laboratories used to develop the JMF, perform Contractor Quality Control testing shall meet the requirements of ASTM D3666. All required test methods shall be performed by an accredited laboratory. Submit a certification of compliance signed by the manager of the laboratory stating that it meets these requirements to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.8 TRANSPORTING AND PLACING

3.8.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F.

3.8.2 Placing

The mix shall be placed in lifts of adequate thickness and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required

thickness and conform to the grade and contour indicated. Waste mixture shall not be broadcast onto the mat or recycled into the paver hopper. Collect waste mixture and dispose off site. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.9 COMPACTION OF MIXTURE

3.9.1 General

a. After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used are at the discretion of the Contractor, with the exception that application of more than three passes with a vibratory roller in the vibrating mode is prohibited. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Correct at once any displacement occurring as a result of reversing the direction of the roller, or from any other cause.

b. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened, but excessive water will not be permitted. In areas not accessible to the roller, thoroughly compact the mixture with hand tampers. Remove the full depth of any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective, replace with fresh hot mixture and immediately compact to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9.2 Segregation

The Contracting Officer can sample and test any material that looks deficient. When the in-place material appears to be segregated, the Contracting Officer has the option to sample the material and have it tested and compared to the aggregate gradation, asphalt content, and in-place density requirements in Table 10. If the material fails to meet these specification requirements, the extent of the segregated material will be removed and replaced the full depth of the layer of asphalt mixture at no additional cost to the Government. When segregation occurs in the mat, take appropriate action to correct the process so that additional segregation does not occur.

3.10 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.10.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.10.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing the adjacent lane), or otherwise defective, shall be cut back a maximum of 3 inches from the top edge of the lift with a cutting wheel to expose a clean, sound, near vertical surface for the full depth of the course. All cutback material shall be removed from the project. Cutting equipment that uses water as a cooling or cutting agent shall not be permitted. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint.

3.10.3 HMA-Portland Cement Concrete Joints

Joints between HMA and PCC will require specific construction procedures for the HMA. The following criteria are applicable to the first 10 feet or paver width of HMA adjacent to the PCC.

a. Pave the HMA side of the joint in a direction parallel to the joint.

b. Place the HMA side sufficiently high so that when fully compacted the HMA will be greater than 1/8 inch but less than 1/4 inch higher than the PCC side of the joint.

c. Compaction shall be provided with steel wheel rollers and at least one rubber tire roller. The rubber tire roller shall be at least 20 tons in weight and have tires that are inflated to at least 90 psi. Avoid spalling the PCC during placement and compaction of the HMA. Steel wheel rollers shall be operated in a way that prevents spalling the PCC. Any damage to PCC edges or joints shall be repaired as directed by the Contracting Officer. If damage to the PCC joint or edge exceeds a total of 3 feet, the PCC panel shall be removed and replaced at no additional expense to the Government.

d. After compaction is finished the HMA shall be leveled by grinding so that the HMA side is less than 1/8 inch higher than the PCC side. The HMA immediately adjacent to the joint shall not be lower than the PCC after the grinding operation. Transition the grinding into the HMA in a way that ensures good smoothness and provides drainage of water. The joint and adjacent materials when completed shall meet all of the requirements for grade and smoothness. Measure smoothness across the

PCC-HMA joint using a 12 feet straightedge. The acceptable tolerance is 1/8 inch.

e. Consider the HMA next to the PCC as a separate lot for evaluation. Lots are based on individual lifts. Do not co-mingle cores from different lifts for density evaluation purposes. Take four cores for each lot of material placed adjacent to the joint. The size of lot shall be 10 feet wide by the length of the joint being paved. Lots are based on individual lifts and shall not be co-mingled for density evaluation purposes. Locate the center of each of the four cores 6 inches from the edge of the concrete. Take each core at a random location along the length of the joint. The requirements for density for this lot, adjacent to the joint, are the same as that for the mat specified earlier.

f. All procedures, including repair of damaged PCC, shall be in accordance with the approved Quality Control Plan.

-- End of Section --

SECTION 32 12 36.19

COAL TAR SEAL COAT WITH UNVULCANIZED RUBBER
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.

ASTM INTERNATIONAL (ASTM)

ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D140/D140M	(2014) Standard Practice for Sampling Bituminous Materials
ASTM D5727/D5727M	(2000; E 2011; R 2011) Emulsified Refined Coal Tar (Mineral Colloid Type)
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates

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.for information only. 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-05 Design Data

Coal tar seal coat mix

SD-06 Test Reports

Coal tar seal materials tests

Submit, showing results of tests specified for various materials.

Coal tar pitch emulsion tests

Aggregate gradation tests

SD-07 Certificates

Construction equipment list

1.3 DELIVERY AND STORAGE

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling. Store aggregates

and protect from contamination and segregation. Store rubberized coal tar pitch emulsion in a manner which will prevent freezing.

1.4 WEATHER LIMITATIONS

Apply the seal coat only in dry weather and when air and pavement temperatures are 50 degrees F and rising. Do not apply seal coat if rain is probable or predicted for the next 8 hours. Do not apply when temperature and humidity conditions are such that rubberized coal tar pitch emulsion could not dry thoroughly before a minimum pavement temperature of 45 degrees F occurs.

1.5 QUALITY ASSURANCE

1.5.1 Required Data

Submit a coal tar seal coat mix design for each type included in work, with test reports, a minimum of 30 days prior to mixing and placing of material. Mix design shall indicate definite percentage of each sieve fraction of aggregate, water content, and percentage of rubberized coal tar emulsion.

1.6 EQUIPMENT

1.6.1 Required List

Submit a list of construction equipment to the Contracting Officer for approval 30 days prior to bringing the equipment on the job site. The Government reserves the right to order discontinuance of use of any equipment which, in the opinion of the Contracting Officer, fails to produce satisfactory work.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Emulsion

Rubberized coal tar pitch emulsion shall consist of coal tar pitch emulsion and unvulcanized rubber. Coal tar pitch emulsion shall conform to ASTM D5727/D5727M. The unvulcanized rubber shall be of a type that is resistant to petroleum distillates. Blend not less than 3 percent by weight of rubber with the coal tar pitch prior to emulsification. Rubberized coal tar pitch emulsion shall be homogeneous and shall show no separation or coagulation of components which cannot be overcome by moderate stirring. Upon curing, the rubberized coal tar pitch emulsion shall provide a continuous, unbroken, adherent film resistant to petroleum distillates. Do not expose the emulsion to freezing temperatures during storage, mixing, and application.

2.1.2 Mineral Aggregate

Provide mineral aggregate of either crushed gravel or crushed stone and free from dirt, organic matter, clay balls, adherent films of clay, dust, or other objectionable matter. Aggregates shall be nonplastic. When tested in accordance with ASTM C136/C136M, grading of aggregate shall conform to the following:

Sieve Designation (Square Opening)	Percentage by Weight Passing
No. 16	100
No. 20	85-100
No. 30	15-85
No. 40	2-15
No. 100	0-5

2.1.3 Water

Potable.

2.1.4 Prime Coat

Undiluted rubberized coal tar pitch emulsion.

2.2 CONSTRUCTION EQUIPMENT

Use equipment adequate for purpose intended, properly maintained, and in safe operating condition at all times.

2.2.1 Cleaning Equipment

Cleaning equipment shall be capable of removing oil, grease, paint, clay, dust, rubber deposits, and other material from surface and cracks of bituminous pavements.

2.2.2 Mixing Equipment

Provide pug mill type mixer, or other equipment approved by the Contracting Officer. Equip mixer with chute and controlled gate for feeding seal coat into the spreader box. Examine mixers daily for changes in condition due to accumulation of hardened mixture or excessively worn blades. Do not use any mixer with an accumulation of hardened mixture or excessively worn blades.

2.2.3 Self-Contained Slurry Machines

Slurry machine shall accurately proportion and thoroughly mix aggregate, water, and rubberized coal tar pitch emulsion into a homogeneous mixture. Provide machine capable of rapid discharge of mixed materials into a spreader having suitable controls to allow adjustment for variations in pavement grades and slopes. Provide spreader similar to the spreader box specified. Spreader box may be either an integral part of a self-contained slurry machine or a separate towed unit. Equip slurry machine with a spray bar capable of placing 0.05 gallon of water per square yard on pavement surface immediately in front of spreader. Mount self-contained slurry unit on a truck or other vehicle capable of producing evenly controlled low rates of speed throughout operation.

2.2.4 Spreader Box

Spreader box shall consist of a frame, squeegee, and baffles. Frame shall be not less than 8 feet in length. Use squeegee of neoprene rubber belting or similar material, 1/2 inch thick and 6 to 8 inches deep. Squeegee shall be anchored to an adjustable frame and held vertically across width of box, with approximately 4 inches of the lower edge free to provide adequate flexibility. Locate squeegee about three-fourths of the distance back from front of frame and adjust for thickness of application. Line front and sides of box with 1/4 inch thick belting bolted through slotted holes so that it can be raised or lowered to maintain contact with pavement surface to prevent slurry leakage and assure proper spreading. Provide longitudinal or diagonal baffles within spreader box to distribute slurry full length of the squeegee.

PART 3 EXECUTION

3.1 CONSTRUCTION

3.1.1 Preparation for Sealing

Scrub areas impregnated with grease, oil, or fuel spillage with detergent and water, and flush surface clean of detergent. Remove traffic paint on surface to be treated by use of traffic paint removal equipment. Clean surfaces of dirt, clay, and other objectionable material by means of power brooms or blowers, supplemented with hand brooms. Clean surface cracks and blow out with compressed air 90 pounds per square inch at the nozzle, immediately before sweeping or vacuum operations. Repair or replace pavements softened by petroleum derivatives or that have failed due to other causes, at least one week prior to application of seal coat.

3.1.2 Prime Coat

Following the preparation for sealing and prior to the application of the seal coat, apply prime coat of undiluted rubberized coal tar pitch emulsion without aggregate at the rate of 0.075 to 0.10 gallon per square yard. Allow prime coat to cure for a minimum of 6 hours and do not disturb until seal coat is placed.

3.1.3 Preparation of Seal Coat

Prepare the seal coat by mixing rubberized coal tar pitch emulsion with water and mineral aggregate. Add from 4 to 6 pounds (oven dry weight) of mineral aggregate for each gallon of undiluted emulsion. Water blended into the mix, for workability, shall not exceed 20 percent by volume of the rubberized coal tar pitch emulsion used, and shall include the surface moisture content of the mineral aggregates. Mix the materials by mechanical mixer as follows: Place rubberized coal tar pitch emulsion into the mixer followed by required amount of water, and blend to a homogeneous consistency. Add mineral aggregate next at a slow, uniform rate to prevent balling or lumping while mixer is rotating. After all ingredients are in mixer, mix together for not less than 5 minutes and as much longer as necessary to obtain a smooth, creamy, homogeneous mixture. Provide continuous mixing from time rubberized coal tar pitch emulsion is placed into mixer until the seal coat is discharged into spreader box or otherwise applied to pavement. During the entire mixing and placing process, if breaking, segregation, hardening of emulsion, balling, or lumping occurs; discard the entire batch.

3.1.4 Application of Seal Coat

Immediately prior to application of the seal coat, dampen pavement prime coat by fog spraying with water at a rate not exceeding 0.05 gallon per square yard. Apply seal coat in two applications using a spreader box supplemented by hand squeegees. Apply the seal coat at a rate of not less than 0.10 gallon of undiluted rubberized coal tar emulsion per square yard of pavement per application. Water content of seal coat shall be in accordance with job mix formula. Carry sufficient amount of seal coat in spreader box at all times to ensure complete coverage is obtained. No segregation of coal tar emulsion and aggregate, streaking, or excessive buildup at joints will be permitted. Use burlap drags fastened to rear of spreader box to smooth the surface. Allow the first application to cure for a minimum period of 6 hours before applying the second coat. Apply the second coat within 24 hours of the first application.

3.1.5 Curing

Allow seal coat to cure a minimum of 24 hours before it is opened to traffic.

3.2 FIELD SAMPLING AND TESTING

3.2.1 Sampling Aggregates

Sample aggregates in accordance with ASTM D75/D75M. Take at least one initial sample from each stockpile. Collect each sample by taking three incremental samples at random to make a composite sample of at least 50 pounds. Take three random samples from each 20 tons of material, or a day's run, thereafter, during course of project. Repeat the above sampling when source of material is changed or when otherwise directed.

3.2.2 Sampling Bituminous Material

Sample rubberized coal-tar pitch emulsion in accordance with ASTM D140/D140M. Sample emulsion immediately after delivery to project site and at any time thereafter if source of material is changed. Take additional samples directly from emulsion storage tanks of slurry seal machine when directed.

3.2.3 Sample Identification

Place each sample of aggregate and rubberized coal tar pitch emulsion in a clean container and securely fasten. Identify each sample with the following information:

Contract No. _____
Sample No. _____ Quantity _____
Date of Sample _____
Sample _____
Source _____
Intended use _____
For testing _____

3.2.4 Aggregate Testing

Test each sample for gradation in accordance with ASTM C136/C136M.

3.2.5 Bituminous Material Tests

Test each sample of rubberized coal tar emulsion for conformance to ASTM D5727/D5727M.

3.3 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with the seal coat material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. Protect the treated areas from traffic for at least 24 hours after application of the seal coat or for time to prevent picking up.

-- End of Section --

SECTION 32 13 11

CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS
11/12

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Measurements

The quantity of concrete to be paid for will be the volume of concrete in cubic yards including thickened edges monolithic curb, where required, placed in the completed and accepted pavement. Concrete will be measured in place in the completed and accepted pavement only within the neat line dimensions shown in the plan and cross section. No deductions will be made for rounded or beveled edges or the space occupied by pavement reinforcement, dowel bars, tie bars, or electrical conduits, nor for any void, or other structure extending into or through the pavement slab, measuring 3 cubic feet or less in volume. No other allowance for concrete will be made unless placed in specified locations in accordance with written instructions previously issued by the Contracting Officer. The quantity of other materials specified herein, and used in the construction of the work covered by this section, will not be measured for payment, but will be considered a subsidiary obligation of the Contractor, covered under the price per cubic yard for concrete. Joint sealing materials are covered in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

1.1.2 Payments

1.1.2.1 Lump Sum

The quantity of concrete will be paid for and included in the lump-sum contract price. If less than 100 percent payment is due based on the pay factors stipulated below, a unit price of $170 per cubic yard will be used for purposes of calculating the payment reduction.

1.1.3 Payment of Lots

When a lot of material fails to meet the specification requirements, that lot will be accepted at a reduced price or shall be removed and replaced. The lowest computed percent payment determined for any pavement characteristic (i.e., thickness, grade, and surface smoothness) discussed below shall be the actual percent payment for that lot. The actual percent payment will be applied to the unit price and the measured quantity of concrete in the lot to determine actual payment. Use results of strength tests to control concreting operations. Strength will be evaluated, but will not be considered for payment adjustment. Any pavement not meeting the required 'specified strength' shall be removed and replaced at no additional cost to the Government.

1.1.4 Payment Adjustment for Smoothness

a. Straightedge Testing: Location and deviation from straightedge for all measurements shall be recorded. When more than 5.0 and less than or equal to 10.0 percent of all measurements made within a lot exceed the

tolerance specified in paragraph "Surface Smoothness", after any reduction of high spots or removal and replacement, the computed percent payment based on surface smoothness will be 95 percent. When more than 10.0 percent and less than or equal to 15.0 percent of all measurements exceed the tolerance, the computed percent payment will be 90 percent. When more than 15.0 and less than or equal to 20.0 percent of all measurements exceed the tolerance, the computed percent payment will be 75 percent. When more than 20.0 percent of the measurements exceed the tolerance, the lot shall be removed and replaced at no additional cost to the Government.

b. Profilograph Testing(Where required): Location and data from all profilograph measurements shall be recorded. When the Profile Index of a 0.1 mile segment of a lot exceeds the tolerance specified in paragraph "Surface Smoothness" by 1.0 inch per mile but less than 2.0 inches per mile, after any reduction of high spots or removal and replacement, the computed percent payment based on surface smoothness will be 95 percent. When the Profile Index exceeds the tolerance by 2.0 inches per mile but less than 3.0 inches per mile, the computed percent payment will be 90 percent. When the Profile Index exceeds the tolerance by 3.0 inches per mile but less than 4.0 inches per mile, the computed percent payment will be 75 percent. When the Profile Index exceeds the tolerance by 4.0 inches per mile or more, the lot shall be removed and replaced at no additional cost to the Government.

c. Aircraft Arresting Systems. The 200 feet of airfield pavement on both the approach and departure sides of the arresting system pendant is a critical area. Consider this area as a separate lot for payment adjustment for smoothness. Protruding objects and undulating surfaces are detrimental to successful tailhook engagements and are not allowable. No exceedance of the tolerances specified in paragraph: "Surface Smoothness" is acceptable. Remove and replace pavements exceeding the tolerances, unless otherwise directed by the Contracting Officer.

1.1.5 Payment Adjustment for Plan Grade

When more than 5.0 and less than or equal to 10.0 percent of all measurements made within a lot are outside the specified tolerance, the computed percent payment for that lot will be 95 percent. When more than 10.0 percent but less than 50 percent are outside the specified tolerances, the computed percent payment for the lot will be 75 percent. In any areas where the deviation from grade exceeds the specified tolerances by 50 percent or more, the deficient area shall be removed and replaced at no additional cost to the Government.

1.1.6 Payment Adjustment for Thickness

Using the Average Thickness of the lot, determine the computed percent payment for thickness by entering the following table:

Computed Percent Payment for Thickness		
	Deficiency in Thickness	
Determined by cores Inches	Pavements Equal To or Over 8 Inches Thick	Pavements Less Than 8 Inches Thick
0.00 to 0.24	100	100
0.25 to 0.49	75	65
0.50 to 0.74	50	0
0.75 or greater	0	0

Where 0 percent payment is indicated, remove the entire lot and replace at no additional cost to the Government. Where either of the two cores from a sublot show a thickness deficiency of 0.75 inch or greater, rill two more cores in the sublot and compute the average thickness of the four cores. If this average shows a thickness deficiency of 0.75 inch or more remove the entire sublot.

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182 (2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1 (1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete

ACI 214R (2011) Evaluation of Strength Test Results of Concrete

ACI 305R (2010) Guide to Hot Weather Concreting

ACI 306R (2010) Guide to Cold Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M (2014) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM A184/A184M (2006; E2011) Standard Specification for Fabricated Deformed Steel Bar Mats for

	Concrete Reinforcement
ASTM A615/A615M	(2014) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2007b; R2014) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A996/A996M	(2014a) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C1017/C1017M	(2013) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064/C1064M	(2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1077	(2014) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123/C123M	(2012) Standard Test Method for Lightweight Particles in Aggregate
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138/C138M	(2014) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142/C142M	(2010) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143/C143M	(2012) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2012) Standard Specification for Mixing

	Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2014a) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C174/C174M	(2013) Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C192/C192M	(2014) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C294	(2012) Standard Descriptive Nomenclature for Constituents of Concrete Aggregates
ASTM C295/C295M	(2012) Petrographic Examination of Aggregates for Concrete
ASTM C31/C31M	(2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2014a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C494/C494M	(2013) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C78/C78M	(2012; E 2013) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88	(2013) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C881/C881M	(2013) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C94/C94M	(2014b) Standard Specification for Ready-Mixed Concrete

ASTM C989/C989M	(2014) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D2995	(1999; R 2009) Determining Application Rate of Bituminous Distributors
ASTM D3665	(2012) Random Sampling of Construction Materials
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates
ASTM E1274	(2003; R 2012) Standard Test Method for Measuring Pavement Roughness Using a Profilograph

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA QC 3	(2011) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CTM 526	(2002) Operation of California Profilograph and Evaluation of Profiles

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 55	(1992) Test Method for Within-Batch Uniformity of Freshly Mixed Concrete
COE CRD-C 662	(2009) Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

1.3 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of concrete pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section, including tolerances for both.

1.3.1 Surface Smoothness

Use the profilograph method for all longitudinal testing, except for paving

lanes less than 200 feet in length. Use the straightedge method for transverse testing, for longitudinal testing where the length of each pavement lane is less than 200 feet, within 200 feet on both the approach and departure sides of an aircraft arresting gear, and at the ends of the paving limits for the project. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.) or existing rough or high PI pavement, finish the surface to meet the approval of the Contracting Officer. Detailed notes shall be kept of the results of the testing and a copy furnished to the Government after each day's testing.

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the limits specified when checked with an approved 12 foot straightedge. Runways and taxiways shall have a variation from the specified straight edge not greater than 1/8 inch in the longitudinal direction and not greater than 1/4 inch in the transverse direction. Runway pavement within 200 feet on both the approach and departure sides of an aircraft arresting gear shall have a variation in the longitudinal direction from the specified straightedge not more than plus or minus 1/8 inch. All other airfield areas shall have a variation from a straight edge not greater than 1/4 inch in either the longitudinal or transverse direction.

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and each 0.1 mile segment of each pavement lot shall have a Profile Index not greater than specified when tested with an approved California-type profilograph. Runways and taxiways shall have a Profile index not greater than 7 inches per mile in the longitudinal direction. Runway and taxiway transverse smoothness shall be measured with the straight edge method and the straight edge requirements shall apply. All other airfield areas shall have a Profile Index not greater than 9 inches per mile in the longitudinal direction.

c. Bumps ("Must Grind" Areas): Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height shall be reduced by diamond grinding in accordance with subparagraph "Diamond Grinding of PCC Surfaces" below until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding.

d. Testing Method: After the concrete has hardened sufficiently to permit walking thereon, but not later than 48 hours after placement, test the entire surface of the pavement in each lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. If any pavement areas are ground, these areas shall be retested immediately after diamond grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane shown on the drawings, regardless of whether the Contractor is allowed to pave two lanes at a time, and at the 1/8th point in from each side of the lane. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints. Transverse testing lines for pilot lanes shall be carried to construction joint lines and for fill-in lanes shall be carried 24 inches across construction joints, and the readings in this area applied to the fill-in lane. Straightedge testing of the longitudinal edges of slipformed pilot lanes shall also be performed before paving

fill-in lanes as specified below.

(1) Straightedge Testing: The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and measuring the maximum gap between the straightedge and the pavement surface. Measurements shall be determined along the entire length of the straight edge.

(2) Profilograph Testing: Perform profilograph testing using approved California profilograph and procedures described in ASTM E1274. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 mile segment of the pavement lot. Grade breaks on aprons shall be accommodated by breaking the profile segment into short sections and repositioning the blanking band on each section. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.4 inch. The profilograph testing of the last 30 feet of a paving lane in the longitudinal direction from each day's paving operation shall be counted on the following day's continuation lane. The profile index shall be computed for each pass of the profilograph (3 per lane) in each 0.1 mile segment. The profile index for each segment shall be the average of the profile indices for each pass in each segment. Profilographs of unequal lengths shall be scaled and proportioned to an equivalent 0.1 mile as outlined in the CTM 526. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

1.3.2 Edge Slump and Joint Face Deformation

a. Edge Slump: When slip-form paving is used, not more than 15.0 percent of the total free edge of each pavement panel shall have an edge slump exceeding 1/4 inch and none of the free edge of the pavement lot shall have an edge slump exceeding 3/8 inch. (A pavement panel is defined as a lane width by the length between two adjacent transverse contraction joints. The total free edge of the pavement will be considered to be the cumulative total linear measurement of pavement panel edge originally constructed as non-adjacent to any existing pavement; i.e., 100 feet of pilot lane originally constructed as a separate lane, will have 200 feet of free edge; 100 feet of fill-in lane will have no free edge, etc.,). The area affected by the downward movement of the concrete along the pavement edge shall not exceed 18 inches back from the edge.

b. Joint Face Deformation: In addition to the edge slump limits specified above, the vertical joint face shall have a surface within the maximum limits shown below:

Offset from Straightedge Applied Logintudinally to Pavement Surface	Offset from Straightedge Applied Longitudinally to Vertical Face	Offset from Straightedge Applied Top to Bottom Against the Joint Face	Abrupt Offset in Any Direction	Offset of Joint Face from True Vertical
Airfield Pavement				
1/8 inch	1/4 inch	3/8 inch	1/8 inch	1 inch/12 inches
All Other Pavement				
1/4 inch	All other items same as airfield pavement			

c. Slump Determination: Immediately after the concrete has hardened sufficiently to permit walking thereon, the pavement surface of each lot shall be tested by the Contractor. Testing shall be performed with a minimum 12 foot straightedge to reveal irregularities exceeding the edge slump tolerance specified above. The vertical edge slump shall be determined at each free edge of each slipformed paving lane constructed. The straightedge shall be placed transverse to the direction of paving and the end of the straightedge located at the edge of the paving lane. Measurements shall be made at 5 to 15 foot spacings, as directed, commencing at the header where paving was started. Initially measurements shall be made at 5 foot intervals in each lane. When no deficiencies are present, the Contracting Officer may approve an increase in the interval. When any deficiencies exist, the interval will be returned to 5 feet. In no case shall the interval exceed 15 feet. In addition to the transverse edge slump determination above, the Contractor, at the same time, shall check the longitudinal surface smoothness of the joint on a continuous line 1 inch back from the joint line using the 12 foot straightedge advanced one-half its length for each reading. Other tests of the exposed joint face shall be made to ensure that a uniform, true vertical joint face is attained. The measurements shall be made by the Contractor, shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Contracting Officer within 24 hours after measurement is made. The report shall also identify areas requiring replacement.

d. Excessive Edge Slump: When edge slump exceeding the limits specified above is encountered on either side of the paving lane, additional straightedge measurements shall be made, if required, to define the linear limits of the excessive slump. The concrete slabs having excessive edge slump or joint deformation shall be removed and replaced to the next transverse joint in conformance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Use of slip-form paving equipment and procedures that fail to consistently provide edges within the specified tolerances on edge slump and joint face deformation shall be discontinued and the pavements shall be constructed by means of standard paving procedures using fixed forms.

1.3.3 Plan Grade

Within 5 days after paving of each lot, the finished surface of the pavement area shall be tested, by running lines of levels at intervals

corresponding with every longitudinal and transverse joint to determine the elevation at each joint intersection. The results of this survey shall be recorded and a copy given to the Government at the completion of the survey of each lot. The finished surfaces of airfield runway, taxiway, and apron pavements shall vary not more than 1/2 inch above or below the plan grade line or elevation indicated. The surfaces of other pavements shall vary not more than 3/4 inch. The above deviations from the approved grade line and elevation will not be permitted in areas where closer conformance with the planned grade and elevation is required for the proper functioning of appurtenant structures. The finished surfaces of new abutting pavements shall coincide at their juncture.

1.3.4 Flexural Strength

Submit certified copies of laboratory test reports and sources for cement, supplementary cementitious materials (SCM), aggregates, admixtures, curing compound, epoxy, and proprietary patching materials proposed for use on this project. All aggregate tests shall have been performed no earlier than 6 months prior to contract award. Each lot of pavement will be evaluated for acceptance in accordance with the following procedures.

a. Sampling and Testing: For acceptance, one composite sample of concrete from each sublot shall be obtained in accordance with ASTM C172/C172M from one batch or truckload. Test cylinders 6 x 12 inches shall be fabricated and cured in accordance with ASTM C31/C31M, and tested in accordance with ASTM C39/C39M Test two test cylinders per sublot (8 per lot) at 14 days.

b. Computations: Average the eight 14-day strength tests for the lot. The average strength shall be used in accordance with paragraph "Concrete Strength for Final Acceptance" in PART 2.

1.3.5 Thickness

Each lot of pavement will be evaluated for acceptance and payment adjustment in accordance with the following procedure. Two cores, between 4 and 6 inches in diameter, shall be drilled from the pavement, per sublot (8 per lot). The Contractor is responsible for drilling the cores within 3 days after lot placement, filling the core holes with an approved non-shrink concrete, respraying the cored areas with curing compound, and for measuring the cores. Each core shall be inspected for voids, thickness of paste on the surface, and depth of reinforcement (if required). Provide the results with the thickness measurement data. Eight measurements of thickness shall be made around the circumference of each core and one in the center, in accordance with ASTM C174/C174M, using calibrated calipers for specimens longer than 10 inches. The pavement thickness from the 8 cores for the lot shall be averaged and shall be evaluated as described in paragraph: PAYMENT ADJUSTMENT FOR THICKNESS above.

1.3.6 Diamond Grinding of PCC Surfaces

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with an approved diamond grinding machine after the concrete is 14 days or more old. Grinding shall be accomplished by sawing with an industrial diamond abrasive which is impregnated in the saw blades. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the

required texture and smoothness level without damage to the concrete pavement or joint faces. The saw blades shall be 1/8-inch wide and there shall be a minimum of 55 to 60 blades per 12 inches of cutting head width depending on the hardness of the aggregate. Each machine shall be capable of cutting a path 3 to 4 ft 3 to 4 ft wide. Grinding equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The area corrected by grinding the surface of the hardened concrete shall not exceed 10 percent of the total area of any sublot. The depth of diamond grinding shall not exceed 1/4 inch. All pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified above, shall be removed and replaced in conformance with paragraph REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. All areas in which diamond grinding has been performed will be subject to the thickness tolerances specified in paragraph: Thickness, above.

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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment
Proposed Techniques; G
Dowels; G
Dowel Bar Assemblies; G

SD-05 Design Data

Proportioning Studies; G

SD-06 Test Reports

Sampling and Testing; G

SD-07 Certificates

Contractor Quality Control Staff
Laboratory Accreditation
NRMCA Certificate of Conformance
Commercial Laboratory

1.5 QUALITY ASSURANCE

1.5.1 Contractor Quality Control Staff

Submit American Concrete Institute certification for Contractor Quality Control staff. Qualifications and resumes for petrographer, surveyor, concrete batch plant operator, and profilograph operator. All Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) certified in the following grade (or shall have written evidence acceptable to the Contracting Officer's representative of having completed similar qualification programs):

a. CQC personnel responsible for inspection of concrete paving operations: ACI Concrete Transportation Inspector.

b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews: ACI Concrete Flatwork Technician/Finisher.

c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.

d. Laboratory Testing Technicians: ACI Concrete Strength Testing Technician and Laboratory Testing Technician, Grade I or II.

1.5.2 Other Staff

Submit for approval, the qualifications and resumes for the following staff:

a. Petrographer: Bachelor of Science degree in geology or petrography, trained in petrographic examination of concrete aggregate according to ASTM C294 and ASTM C295/C295M and trained in identification of the specific deleterious materials and tests identified in this specification. Resume shall detail the education, training and experience related to the project-specific test methods and deleterious materials and shall be submitted at least 20 days before petrographic and deleterious materials examination is to commence.

b. Licensed Surveyor: All survey work shall be performed under the supervision of a Licensed Surveyor.

c. Concrete Batch Plant Operator: National Ready Mix Concrete Association (NRMCA) Plant Manager certification at the Plant Operator level.

d. Profilograph Operator: Certification by equipment manufacturer or a state Department of Transportation.

1.5.3 Laboratory Accreditation

Laboratory and testing facilities shall be provided by and at the expense of the Contractor. Submit accreditation of the commercial laboratory by an independent evaluation authority, indicating conformance to ASTM C1077, including all applicable test procedures. The laboratories performing the tests shall be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation shall be current and shall include the required and optional test methods, as specified throughout this Section. Onsite temperature-controlled concrete curing facilities shall be provided.

a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies shall be performed by a commercial laboratory.

b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Steel molds shall be used for molding the beam specimens. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M. Flexural loading equipment shall be in accordance with ASTM C78/C78M.

c. Contractor Quality Control: All sampling and testing shall be performed by an approved, onsite, independent, commercial laboratory, or for cementitious materials and admixtures, the manufacturer's laboratory. Submit USACE validation letter for commercial laboratory.

d. Laboratory Inspection: The Government will inspect the laboratory equipment and test procedures prior to the start of concreting operations for conformance to ASTM C1077. The laboratory shall maintain this certification for the duration of the project.

1.5.4 Preconstruction Testing of Materials

All sampling and testing shall be performed by, and at the expense of, the Contractor. Use an approved commercial laboratory or, for cementitious materials and chemical admixtures, a laboratory maintained by the manufacturer of the material. No material shall be used until notice of acceptance has been given. The Contractor will not be entitled to any additional payment or extension of time due to failure of any material to meet project requirements, or for any additional sampling or testing required. Additional tests may be performed by the Government at the discretion of the Contracting Officer; such Government testing will not relieve the Contractor of any testing responsibilities.

1.5.4.1 Aggregates

Aggregates shall be sampled in the presence of a Government Representative. Samples shall be obtained in accordance with ASTM D75/D75M and shall be representative of the materials to be used for the project. Test results shall be submitted 7 days before commencing mixture proportioning studies.

1.5.4.2 Chemical Admixtures, Curing Compounds and Epoxies

At least 30 days before the material is used, submit certified copies of test results for the specific lots or batches to be used on the project. Test results shall be not more than 6 months old prior to use in the work. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing will be retested at the expense of the Contractor and will be rejected if test results are not satisfactory.

1.5.4.3 Cementitious Materials

Cementwill be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports showing that the material in each shipment meets the requirements of the specification under which it is furnished. Mill test reports shall be no more than 1 month old, prior to use in the work. No cementitious material shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious material may be subjected to testing by the Government from samples obtained at the mill, at transfer points, or at the project site. If tests prove that a cementitious material that has been delivered is unsatisfactory, it shall be promptly removed from the site of the work. Cementitious material that has not been used within 6 months after testing shall be retested at the Contractor's expense and shall be rejected if test results are not satisfactory.

1.5.5 Testing During Construction

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials, and concrete as specified herein. The Government will sample and test concrete and ingredient materials as considered appropriate. Provide facilities and labor as may be necessary

for procurement of representative test samples. Testing by the Government will in no way relieve the Contractor of the specified testing requirements.

1.5.6 Test Section

Up to 10 days, but not more than 60 days, prior to construction of the concrete pavement, construct a test section near the job site, but not as part of the production pavement area. Use the test section to develop and demonstrate to the satisfaction of the Contracting Officer the proposed techniques of mixing, hauling, placing, consolidating, finishing, curing, initial saw cutting, start-up procedures, testing methods, plant operations, and the preparation of the construction joints. Variations in mixture proportions, other than water, shall be made if directed. Vary the water content, as necessary, to arrive at the appropriate content. The mixing plant shall be operated and calibrated prior to start of placing the test section. Use the same equipment, materials, and construction techniques on the test section as will be used in all subsequent work. Base course preparation, concrete production, placing, consolidating, curing, construction of joints, and all testing shall be in accordance with applicable provisions of this specification. Three days after completion of the test section, provide eight cores at least 6 inch diameter by full depth cut from points selected in the test section by the Government. The cores will be evaluated for homogeneity, consolidation and segregation. Construct the test section meeting all specification requirements and being acceptable to the Contracting Officer in all aspects, including surface texture. Failure to construct an acceptable test section will necessitate construction of additional test sections at no additional cost to the Government. Test sections allowed to be constructed as part of the production paving which do not meet specification requirements shall be removed at the Contractor's expense. If the Contractor proposes to use slipform paving and is unable to construct an acceptable test section, the slipform paving equipment shall be removed from the job and the construction completed using stationary side forms and equipment compatible with them. Production paving shall not commence until the results on aggregates and concrete, including evaluation of the cores, and all pavement measurements for edge slump, joint face deformation, actual plan grade, surface smoothness and thickness have been submitted and approved by the Contracting Officer. Pavement accepted as a production lot will be evaluated and paid in accordance with Paragraph: ACCEPTABILITY OF WORK below.

1.5.6.1 Pilot Lane

The test section shall consist of one paving lane at least 400 feet long and shall be constructed to the same thickness as the thickest portion of pavement shown on the Drawings. The lane width shall be the same as that required for use in the project. The test section shall contain at least one transverse construction joint. If doweled longitudinal construction joints are required in any of the production pavements, they shall be installed full length along one side of the test strip throughout the test section. Two separate days shall be used for construction of the test section.

1.5.6.2 Fill-In Lane

The first 400 feet of the initial production fill-in lane shall be considered a fill-in lane test section for purposes of testing and evaluation. All requirements for the test section are applicable, as appropriate. Obtain cores from the fill-lane lane side of the longitudinal

construction joint with the pilot lane. The cores will be evaluated for homogeneity, consolidation, and segregation.

1.5.7 Acceptability of Work

The materials and the pavement itself will be accepted on the basis of tests made by the Contractor. The Government may make check tests to validate the results of the Contractor's testing. If the results of the Contractor tests vary by less than 2.0 percent of the Government's test results, the results of the Contractor's tests will be used. If the results of the Government and Contractor tests vary by 2.0 percent, but less than 4.0 percent, the average of the two will be considered the value to be used. If these vary by 4.0 percent or more, each sampling and testing procedure shall be carefully evaluated and both the Government and the Contractor shall take another series of tests on duplicate samples of material. If these vary by 4.0 percent or more, the results of the tests made by the Government shall be used and the Government will continue check testing of this item on a continuous basis until the two sets of tests agree within less than 4.0 percent on a regular basis. Testing performed by the Government will in no way at any time relieve the Contractor from the specified testing requirements.

1.5.8 Acceptance Requirements

1.5.8.1 Pavement Lots

A lot will be that quantity of construction that will be evaluated for acceptance with specification requirements. A lot will be equal to one shift of production not to exceed 1000 cubic yards. In order to evaluate thickness, each lot will be divided into four equal sublots. Grade determinations will be made on the lot as a whole. Surface smoothness determinations will be made on every 0.1 mile segment in each lot. Location of all samples shall be selected on a random basis in accordance with ASTM D3665. When operational conditions cause a lot to be terminated before the specified four sublots have been completed, the following procedure shall be used to adjust the lot size and number of tests for the lot. Where three sublots have been completed, they shall constitute a lot. Where one or two sublots have been completed, they shall be incorporated into the next lot (except for the last lot), and the total number of sublots shall be used and acceptance criteria adjusted accordingly.

1.5.8.2 Evaluation

Provide all sampling and testing required for acceptance and payment adjustment at the Contractor's expense. Individuals performing sampling, testing and inspection duties shall meet the required Qualifications. The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. Testing in these areas will be in addition to the sublot or lot testing, and the requirements for these areas will be the same as those for a sublot or lot. Provide facilities for and, where directed, personnel to assist in obtaining samples for any Government testing.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Bulk Cementitious Materials

Furnish all cementitious material in bulk. The temperature of the

cementitious material, as delivered to storage at the site, shall not exceed 150 degrees F. Sufficient cementitious materials shall be in storage to sustain continuous operation of the concrete mixing plant while the pavement is being placed. Provide separate facilities to prevent any intermixing during unloading, transporting, storing, and handling of each type of cementitious material.

1.6.2 Aggregate Materials

Store aggregate at the site of the batching and mixing plant avoiding breakage, segregation, intermixing or contamination by foreign materials. Each size of aggregate from each source shall be stored separately in free-draining stockpiles. Aggregate stored on ground shall have a minimum 24 inch thick sacrificial layer left undisturbed. Fine aggregate and the smallest size coarse aggregate shall remain in free-draining storage for at least 24 hours immediately prior to use. Sufficient aggregate shall be maintained at the site at all times to permit continuous uninterrupted operation of the mixing plant at the time concrete pavement is being placed. Tracked equipment shall not be allowed on coarse aggregate stockpiles.

1.6.3 Other Materials

Store reinforcing bars and accessories above the ground on supports. All materials shall be stored avoiding contamination and deterioration.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement, blended cement or only portland cement in combination with supplementary cementitious materials (SCM), and shall conform to appropriate specifications listed below. New submittals are required when the cementitious materials sources or types change.

2.1.1 Portland Cement

Provide portland cement conforming to ASTM C150/C150M, Type III, low alkali .

2.1.2 Pozzolan

2.1.2.1 Fly Ash

Fly ash shall conform to ASTM C618, Class F, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity shall have a total equivalent alkali content less than 3 percent.

2.1.2.2 Raw or Calcined Natural Pozzolan

Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 3 6 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total equivalent alkali content less than 3 percent.

2.1.2.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:

a. The strength activity index at 28 days of age shall be at least 95 percent of the control specimens.

b. The average particle size shall not exceed 6 microns.

2.1.3 Ground Granulated Blast-Furnace (GGBF) Slag

Ground Granulated Blast-Furnace Slag shall conform to ASTM C989/C989M, Grade 100 or Grade 120.

2.2 AGGREGATES

2.2.1 Aggregate Sources

2.2.1.1 Durability

Fine and coarse aggregates to be used in all concrete shall be evaluated and tested for durability in accordance with ASTM C88. Results shall not show more than 18 percent loss when subjected to 5 cycles using Magnesium Sulfate. If Sodium Sulfate is used, results shall not show more than 12 percent loss when subjected to 5 cycles.

2.2.1.2 Alkali-Silica Reactivity

Fine and coarse aggregates to be used in all concrete shall be evaluated and tested for alkali-aggregate reactivity. Both coarse aggregate size groups shall be tested.

a. The fine and coarse aggregates shall be evaluated separately, using ASTM C1260. Test results of the individual aggregates shall have a measured expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Should the test data indicate an expansion of greater than 0.08 percent, the aggregate(s) shall be rejected or additional testing shall be performed as follows: utilize the Contractor's proposed low alkali portland cement, blended cement, and/or SCM, and/or Lithium Nitrate in combination with each individual aggregate. If only SCMs are being evaluated, the testing shall be in accordance with ASTM C1567. If Lithium Nitrate is being evaluated, with or without SCMs, the testing shall be in accordance with COE CRD-C 662. Determine the quantity that will meet all the requirements of these specifications and that will lower the expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Mixture proportioning shall be based on the highest percentage of SCM required to mitigate ASR-reactivity

b. If any of the above options does not lower the expansion to less than 0.08 percent after 28 days of immersion in a 1N NaOH solution, reject the aggregate(s) and submit new aggregate sources for retesting. Submit the results of testing to the Contracting Officer for evaluation and acceptance.

2.2.1.3 Combined Aggregate Gradation

In addition to the grading requirements specified for coarse aggregate and

for fine aggregate, the combined aggregate grading shall meet the following requirements:

a. The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in d. below, the point thus determined shall fall within the parallelogram described therein.

b. The Coarseness Factor (CF) shall be determined from the following equation:

CF = (cumulative percent retained on the 3/8 in. sieve)(100)/(cumulative percent retained on the No. 8 sieve)

c. The Workability Factor WF is defined as the percent passing the No. 8 sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds of cementitious material per cubic yard greater than 564 pounds per cubic yard.

d. A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary.)

2.2.2 Coarse Aggregate

Coarse Aggregate shall meet Standard Construction Specifications, latest edition.

2.2.3 Fine Aggregate

Fine Aggregate shall meet Standard Construction Specifications, latest edition.

2.2.3.1 Grading

Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33/C33M and shall have a fineness modulus of not less than 2.50 nor more than 3.40.

2.2.3.2 Deleterious Material

Sample size for fine aggregate proposed for use in airfield paving shall be 10 pounds. The amount of deleterious material in the fine aggregate shall not exceed the following limits by mass:

Material	Percentage by Mass
Clay lumps and friable particles ASTM C142/C142M	1.0
Material finer than No. 200 sieve ASTM C117	3.0

Material	Percentage by Mass
Lightweight particles ASTM C123/C123M using a medium with a density of Sp. Gr. of 2.0	0.5
Total of all above	3.0

2.3 CHEMICAL ADMIXTURES

2.3.1 General Requirements

Chemical admixtures may only be used when the specific admixture type and manufacturer is the same material used in the mixture proportioning studies. The air-entraining admixture shall conform to ASTM C260/C260M. An accelerator conforming to ASTM C494/C494M, Type C, may be used only when specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES below and shall not be used to reduce the amount of cementitious material used. Calcium chloride and admixtures containing calcium chloride shall not be used. Retarding or water-reducing admixture shall meet the requirements of ASTM C494/C494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived. ASTM C494/C494M, Type F and G high range water reducing admixtures and ASTM C1017/C1017M flowable admixtures shall not be used.

2.3.2 Lithium Nitrate

The lithium admixture shall be a nominal 30 percent aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon, and shall have the approximate chemical form as shown below:

Constituent	Limit (Percent by Mass)
$LiNo_3$ (Lithium Nitrate)	30 +/- 0.5
SO_4^{-2} (Sulfate Ion)	0.1 (max)
Cl^- (Chloride Ion)	0.2 (max)
Na^+ (Sodium Ion)	0.1 (max)
K^+ (Potassium Ion)	0.1 (max)

Provide a trained representative to supervise the lithium nitrate admixture dispensing and mixing operations.

2.4 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water, or water from concrete production operations, may be used if it meets the requirements of ASTM C1602/C1602M.

2.5 JOINT MATERIALS

2.5.1 Expansion Joint Material

Expansion joint filler shall be a preformed material conforming to ASTM D1751 Expansion joint filler shall be 3/4 inch thick, unless otherwise indicated, and shall be furnished in a single full depth piece.

2.5.2 Slip Joint Material

Slip joint material shall be 1/4 inch thick expansion joint filler, unless otherwise indicated, conforming to paragraph: Expansion Joint Material.

2.6 REINFORCING

All reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete. Removal of thin powdery rust and tight rust is not required. However, reinforcing steel which is rusted to the extent that it does not conform to the required dimensions or mechanical properties shall not be used.

2.6.1 Reinforcing Bars and Bar Mats

Reinforcing bars shall conform to ASTM A615/A615M, billet-steel , Grade 60 . Bar mats shall conform to ASTM A184/A184M. The bar members may be billet rail or axle steel.

2.6.2 Welded Wire Reinforcement

Welded Wire Reinforcement shall be deformed or smooth, conforming to ASTM A1064/A1064M, and shall be furnished in flat sheets.

2.7 DOWELS AND TIE BARS

2.7.1 Dowels

Dowels shall be single piece bars fabricated or cut to length at the shop or mill before delivery to the site. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight. Dowels may be sheared to length provided that the deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and does not extend more than 0.04 inch from the end of the dowel. Dowels shall be plain (non-deformed) steel bars conforming to ASTM A615/A615M, Grade 40 or 60; ASTM A996/A996M, Grade 50 or 60. Dowel bars shall be epoxy coated in conformance with ASTM A775/A775M. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the epoxy hardens. Dowel sleeves or inserts are not permitted.

2.7.2 Dowel Bar Assemblies

Dowel bar assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels throughout the paving operation, with a minimum of four continuous bars or wires extending along the joint line. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from rising, sliding out, or becoming distorted during paving operations.

2.7.3 Tie Bars

Tie bars shall be deformed steel bars conforming to ASTM A615/A615M, or ASTM A996/A996M, Grade 60 , and of the sizes and dimensions indicated. Deformed rail steel bars and high-strength billet or axle steel bars, Grade 50 or higher, shall not be used for bars that are bent and straightened during construction.

2.8 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881/C881M, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for use for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

2.9 EQUIPMENT

All plant, equipment, tools, and machines used in the work shall be maintained in satisfactory working conditions at all times. Submit the following:

a. Details and data on the batching and mixing plant prior to plant assembly including manufacturer's literature showing that the equipment meets all requirements specified herein.

b. Obtain National Ready Mixed Concrete Association (NRMCA) certification of the concrete plant. The concrete plant shall be inspected by an engineer approved by the NRMCA. A list of NRMCA approved engineers is available on the NRMCA website at http://www.nrmca.org. All fees and costs associated with this inspection shall be paid by the Contractor. Submit a copy of the NRMCA QC Manual Section 3 Concrete Plant Certification Checklist, NRMCA Certificate of Conformance, and Calibration documentation on all measuring and weighing devices prior to uniformity testing.

c. A description of the equipment proposed for transporting concrete mixture from the central mixing plant to the paving equipment.

d. A description of the equipment proposed for the machine and hand placing, consolidating and curing of the concrete mixture. Manufacturer's literature on the paver and finisher, together with the manufacturer's written instructions on adjustments and operating procedures necessary to assure a tight, smooth surface on the concrete pavement. The literature shall show that the equipment meets all details of these specifications.

2.9.1 Batching and Mixing Plant

a. Location: The batching and mixing plant shall be located off Government premises no more than 15 minutes haul time from the placing site There shall be operable telephonic or radio communication between the plant and the placing site at all times concreting is taking place.

b. Type and Capacity: The batching and mixing plant shall be a stationary-type central mix plant, including permanent installations or portable/relocatable plants installed on stable foundations. The plant shall be designed and operated to produce concrete within the specified tolerances, and shall have a capacity of at least 250 cubic yards per hour. The batching and mixing plant shall conform to the requirements of NRMCA QC 3 including provisions addressing:

1. Material Storage and Handling
2. Batching Equipment
3. Central Mixer
4. Ticketing System
5. Delivery System

c. Tolerances: The following tolerances shall apply.

Materials	Percentage of Required Mass
Cementitious Materials	plus or minus 1
Aggregate	plus or minus 2
Water	plus or minus 1
Admixture	plus or minus 3

For volumetric batching equipment for water and admixtures, the above numeric tolerances shall apply to the required volume of material being batched. Concentrated admixtures shall be uniformly diluted, if necessary, to provide sufficient volume per batch to ensure that the batchers will consistently operate within the above tolerance.

d. Moisture Control: The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates and to change the quantities of the materials being batched.

2.9.2 Concrete Mixers

a. General: Mixers shall be stationary or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Mixer blades or paddles shall be replaced when worn down more than 10 percent of their depth when compared with the manufacturer's dimension for new blades or paddles.

b. Stationary: Stationary mixers shall be drum or pan mixers. Mixers shall be provided with an acceptable device to lock the discharge

mechanism until the required mixing time has elapsed.

c. Mixing Time and Uniformity for Stationary Mixers: For stationary mixers, before uniformity data are available, the mixing time for each batch after all solid materials are in the mixer, provided that all of the mixing water is introduced before one-fourth of the mixing time has elapsed, shall be 1 minute for mixers having a capacity of 1 cubic yard. For mixers of greater capacity, this minimum time shall be increased 20 seconds for each additional 1.33 cubic yard or fraction thereof. After results of uniformity tests are available, the mixing time may be reduced to the minimum time required to meet uniformity requirements; but if uniformity requirements are not being met, the mixing time shall be increased as directed. The mixing time for full batch production shall be a minimum of 75 seconds. Mixer performance tests at new mixing times shall be performed immediately after any change in mixing time. The Regular Test sequence shall be conducted for initial determination of the mixing time or as directed. When regular testing is performed, the concrete shall meet the limits of any five of the six uniformity requirements listed in Table 1 below.

d. The Abbreviated Test sequence shall be conducted for production concrete verification at the frequency specified in Table 6. When abbreviated testing is performed, the concrete shall meet only those requirements listed for abbreviated testing. The concrete proportions used for uniformity tests shall be as used on the project. Regular testing shall consist of performing all six tests on three batches of concrete. The range for regular testing shall be the average of the ranges of the three batches. Abbreviated testing shall consist of performing the three required tests on a single batch of concrete. The range for abbreviated testing shall be the range for one batch. If more than one mixer is used and all are identical in terms of make, type, capacity, condition, speed of rotation, etc., the results of tests on one of the mixers shall apply to the others, subject to the approval of the Contracting Officer. All mixer performance (uniformity) testing shall be performed in accordance with COE CRD-C 55 and with paragraph titled TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3.

TABLE 1 UNIFORMITY REQUIREMENTS--STATIONARY MIXERS

Parameter	Regular Tests Allowable Maximum Range for Average of 3 Batches	Abbreviated Tests Allowable Maximum Range for 1 Batch
Unit weight of air-free mortar	2.0 lbs/cubic ft	2.0 lbs/cubic ft
Air content	1.0 percent	--
Slump	1.0 inch	1.0 inch
Coarse aggregate	6.0 percent	6.0 percent
Compressive strength at 7 days	10.0 percent	10.0 percent
Water content	1.5 percent	

e. Truck: Truck mixers shall not be used for mixing or transporting slipformed paving concrete. The only truck mixers used for mixing or transporting paving concrete shall be those designed with extra large blading and rear opening specifically for low-slump paving concrete. Truck mixers, the mixing of concrete therein, and concrete uniformity and testing thereof shall conform to the requirements of ASTM C94/C94M. The number of revolutions between 70 to 100 for truck-mixed concrete and the number of revolutions for shrink-mixed concrete shall be determined by uniformity tests as specified in ASTM C94/C94M and in requirements for mixer performance stated in paragraph TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3. If requirements for the uniformity of concrete are not met with 100 revolutions of mixing after all ingredients including water are in the truck mixer drum, the mixer shall not be used until the condition is corrected. Water shall not be added after the initial introduction of mixing water except, when on arrival at the job site, the slump is less than specified and the water-cement ratio is less than that given as a maximum in the approved mixture. Additional water may be added to bring the slump within the specified range provided the approved water-cement ratio is not exceeded. Water shall be injected into the head of the mixer (end opposite the discharge opening) drum under pressure, and the drum or blades shall be turned a minimum of 30 additional revolutions at mixing speed. Water shall not be added to the batch at any later time. Mixer performance (uniformity) tests for truck mixers shall be made in accordance with ASTM C94/C94M.

2.9.3 Transporting Equipment

Slipform concrete shall be transported to the paving site in nonagitating equipment conforming to ASTM C94/C94M or in approved agitators. Fixed form concrete shall be transported in approved truck mixers designed with extra large blading and rear opening specifically for low slump concrete. All transporting equipment shall be designed and operated to deliver and discharge the required concrete mixture completely without segregation.

2.9.4 Curing Equipment

Equipment for applying membrane-forming curing compound shall be mounted on a self-propelled frame that spans the paving lane. The reservoir for curing compound shall be constantly mechanically (not air) agitated during operation and shall contain means for completely draining the reservoir. The spraying system shall consist of a mechanically powered pump which will maintain constant pressure during operation, an operable pressure gauge, and either a series of spray nozzles evenly spaced across the lane to give uniformly overlapping coverage or a single spray nozzle which is mounted on a carriage which automatically traverses the lane width at a speed correlated with the forward movement of the overall frame. All spray nozzles shall be protected with wind screens. Calibrate the spraying system in accordance with ASTM D2995, Method A, for the rate of application required in paragraph: Membrane Curing. Any hand-operated sprayers allowed by that paragraph shall be compressed air supplied by a mechanical air compressor. If the curing equipment fails to apply an even coating of compound at the specified rate, it shall immediately be replaced.

2.9.5 Texturing Equipment

a. General: Texturing equipment shall be as specified below. Before use, the texturing equipment shall be demonstrated on a test section, and the equipment shall be modified as necessary to produce the texture

directed.

b. Burlap Drag: A burlap drag shall be securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. Length of the material shall provide 24 to 36 inches dragging flat on the pavement surface. Width shall be at least equal to the width of the slab. The material shall be clean, reasonably new burlap, completely saturated with water before attachment to the frame, always resaturated before start of use, and kept clean and saturated during use. Burlap shall conform to AASHTO M 182, Class 3 or 4.

2.9.6 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-type concrete saws mounted on a wheeled chassis which can be easily guided to follow the required alignment. Blades shall be diamond tipped. If demonstrated to operate properly, abrasive blades may be used. Provide spares as required to maintain the required sawing rate. Wheel saws used in the removal of concrete shall be saws with large diameter tungsten carbide tipped blades mounted on a heavy-duty chassis which will produce a saw kerf at least 1-1/2 inch wide. All saws shall be capable of sawing to the full depth required. Early-entry saws may be used, subject to demonstration and approval of the Contracting Officer. No change to the initial sawcut depth shall be permitted.

2.9.7 Straightedge

Furnish and maintain at the job site, in good condition, one 12 foot straightedge for each paving train for testing the hardened portland cement concrete surfaces. These straightedges shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

2.10 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

2.10.1 Specified Flexural Strength

Specified flexural strength, R, for concrete is 6,500 psi at 28 days, as determined by tests made in accordance with ASTM C78/C78M of beams fabricated and cured in accordance with ASTM C192/C192M. Maximum allowable water-cementitious material ratio is 0.45. The water-cementitious material ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus SCM by the mass equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 6 plus or minus 1.5 percentage points, at the point of placement. Air content shall be determined in accordance with ASTM C231/C231M. The maximum allowable slump of the concrete at the point of placement shall be 2 inches for pavement constructed with fixed forms. For slipformed pavement, at the start of the project, select a maximum allowable slump which will produce in-place pavement meeting the specified tolerances for control of edge slump. The selected slump shall be applicable to both pilot and fill-in lanes.

2.10.2 Concrete Temperature

The temperature of the concrete as delivered shall conform to the requirements of paragraphs, Paving in Hot Weather and Paving in Cold

Weather, in PART 3. Temperature of concrete shall be determined in accordance with ASTM C1064/C1064M.

2.10.3 Concrete Strength for Final Acceptance

The strength of the concrete will be considered acceptable when the average equivalent 28-day flexural strengths for each lot are above the 'Specified Flexural Strength' as determined by correlation with 14-day compressive strength tests specified in paragraph: "Mixture Proportioning for Flexural Strength" belowand no individual set (2 specimens per sublot) in the lot are 25 psi or more below the equivalent 'Specified Flexural Strength'. If any lot or sublot, respectively, fails to meet the above criteria, the lot or sublot shall be removed and replaced at no additional cost to the Government. This is in addition to and does not replace the average strength required for day-to-day CQC operations as specified in paragraph: Average CQC Flexural Strength Required for Mixtures, below.

2.11 MIXTURE PROPORTIONS

2.11.1 Composition

Concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. Supplementary Cementitious Materials (SCM) choice and usage shall be in accordance with paragraph: Supplementary Cementitious Materials (SCM) Content. The total cementitious material content shall be at least 470 lb./cu. yd. . Admixtures shall consist of air entraining admixture and may also include, as approved, accelerator.

2.11.2 Proportioning Studies

Trial design batches, mixture proportioning studies, and testing requirements are the responsibility of the Contractor. Submit the results of the mixture proportioning studies signed and stamped by the registered professional engineer having technical responsibility for the mix design study, and submitted at least 30 days prior to commencing concrete placing operations. The results shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition. The recommended mixture proportions shall be accompanied by test results demonstrating that the proportions selected will produce concrete of the qualities indicated. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in ACI 211.1, modified as necessary to accommodate flexural strength. Submit test results including:

a. Coarse and fine aggregate gradations and plots.
b. Combined aggregate gradation and coarseness/workability plots.
c. Coarse aggregate quality test results, include deleterious materials.
d. Fine aggregate quality test results.
e. Mill certificates for cement and supplemental cementitious materials.
f. Certified test results for air entraining, water reducing, retarding, non-chloride accelerating, and Lithium Nitrate admixtures.
g. Specified flexural strength, slump, and air content.
h. Documentation of required average CQC flexural strength, Ra.
i. Recommended proportions/volumes for proposed mixture and each of three trial water-cementitious materials ratios.
j. Individual beam and cylinder breaks.
k. Flexural and compressive strength summaries and plots.

l. Correlation ratios for acceptance testing and CQC testing.
m. Historical record of test results, documenting production standard deviation (if available).

2.11.2.1 Water-Cement Ratio

At least three different water-cement ratios, which will produce a range of strength encompassing that required on the project, shall be used. The maximum allowable water-cement ratio required in paragraph: Specified Flexural Strength, above will be the equivalent water-cement ratio. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content.

2.11.2.2 Trial Mixture Studies

Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for each placing method (slip form, fixed form, or hand placement) proposed. The temperature of concrete in each trial batch shall be reported. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

2.11.2.3 Mixture Proportioning for Flexural Strength

The following step by step procedure shall be followed:

a. Fabricate all beams for each mixture from the same batch or blend of batches. Fabricate and cure all beams in accordance with ASTM C192/C192M, using 6 x 6 inch steel beam forms.

b. Cure test beams from each mixture for 3, 7, 14, and 28-day flexural tests; 6 beams to be tested per age.

c. Test beams in accordance with ASTM C78/C78M.

d. Using the average strength for each w/c at each age, plot all results from each of the three mixtures on separate graphs for w/c versus:
    3-day flexural strength
    7-day flexural strength
    14-day flexural strength
    28-day flexural strength

e. From these graphs select a w/c that will produce a mixture giving a 28 -day flexural strength equal to the required strength determined in accordance with the next paragraph.

f. Using the above selected w/c, select from the graphs the expected 3, 7 and 14-day flexural strengths.

g. From the above expected strengths for the selected mixture, determine the Ratio of the 7-day flexural strength of the selected mixture to the 28 90-day flexural strength of the mixture (for CQC control).

h. From the above expected strengths for the selected mixture, determine

the Ratio of the 14-day flexural strength of the selected mixture to the 28-day flexural strength of the mixture (for acceptance).

i. If there is a change in materials, additional mixture design studies shall be made using the new materials and new Correlation Ratios shall be determined.

j. No concrete pavement shall be placed until the Contracting Officer has approved the Contractor's mixture proportions. The approved water-cementitious materials ratio shall not exceed the maximum value specified in paragraph: Specified Flexural Strength, above and shall not be increased without the Contracting Officer's written approval.

2.11.3 Average CQC Flexural Strength Required for Mixtures

In order to ensure meeting the strength requirements specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES above, during production, the mixture proportions selected during mixture proportioning studies and used during construction shall produce a required average CQC flexural strength exceeding the specified strength, R, by the amount indicated below. This required average CQC flexural strength, Ra, will be used only for CQC operations as specified in paragraph: TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3 and as specified in the previous paragraph. During production, the required Ra shall be adjusted , as appropriate and as approved, based on the standard deviation of equivalent 28-day strengths being attained during paving.

a. From Previous Test Records: Where a concrete production facility has previous test records current to within 18 months, a standard deviation shall be established in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified flexural strength or strengths within 150 psi of the 28-day flexural strength specified for the proposed work, and shall consist of at least 30 consecutive tests. Perform verification testing, as directed by the Contracting Officer, to document the current strength. A strength test shall be the average of the strengths of two specimens made from the same sample of concrete and tested at 28 days. Required average CQC flexural strength, Ra, used as the basis for selection of concrete proportions shall be the value from the equation that follows, using the standard deviation as determined above:

$$Ra = R + 1.34S$$

Where: S = standard deviation
R = specified flexural strength
Ra = required average flexural strength

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

b. Without Previous Test Records: When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength, Ra, shall be determined by adding 15 percent to the specified flexural strength, R.

PART 3 EXECUTION

3.1 PREPARATION FOR PAVING

Before commencing paving, perform the following. If used, forms shall be in place, cleaned, coated, and adequately supported. Any reinforcing steel needed shall be at the paving site. All transporting and transfer equipment shall be ready for use, clean, and free of hardened concrete and foreign material. Equipment for spreading, consolidating, screeding, finishing, and texturing concrete shall be at the paving site, clean and in proper working order. All equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the paving site, in proper working condition, and in sufficient amount for the entire placement.

3.1.1 Weather Precaution

When windy conditions during paving appear probable, equipment and material shall be at the paving site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.2 Proposed Techniques

Submit placing and protection methods; paving sequence; jointing pattern; data on curing equipment and profilographs; demolition of existing pavements, as specified; pavement diamond grinding equipment and procedures. Submit for approval the following items:

a. A description of the placing and protection methods proposed when concrete is to be placed in or exposed to hot, cold, or rainy weather conditions.

b. A detailed paving sequence plan and proposed paving pattern showing all planned construction joints; transverse and longitudinal dowel bar spacing; and identifying pilot lanes and hand placement areas. No deviation from the jointing pattern shown on the drawings shall be made without written approval of the design engineer.

c. Plan and equipment proposed to control alignment of sawn joints within the specified tolerances.

d. Data on the curing equipment, media and methods to be used.

e. Data on profilograph and methods to measure pavement smoothness.

f. Pavement demolition work plan, presenting the proposed methods and equipment to remove existing pavement and protect pavement to remain in place.

3.2 CONDITIONING OF UNDERLYING MATERIAL

3.2.1 General Procedures

Underlying material, upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. Prior to setting forms or placement of concrete, the underlying material shall be well drained and shall have been satisfactorily graded by string-line controlled, automated, trimmer/fine grader and uniformly compacted in accordance with the applicable Section of these specifications. The surface of the underlying material shall be tested as to crown, elevation, and density in advance of setting forms or of concrete placement using slip-form techniques. High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade, or filled with concrete monolithically with the pavement. Low areas filled with concrete shall not be cored for thickness to avoid biasing the average thickness used for evaluation and payment adjustment. Any underlying material disturbed by construction operations shall be reworked and recompacted to specified density immediately in front of the paver. If a slipform paver is used, the same underlying material under the paving lane shall be continued beyond the edge of the lane a sufficient distance and shall be thoroughly compacted and true to grade to provide a suitable trackline for the slipform paver and firm support for the edge of the paving lane.

3.2.2 Traffic on Underlying Material

After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon. Subject to specific approval, crossing of the prepared underlying material at specified intervals for construction purposes may be permitted, provided rutting or indentations do not occur. The surface shall be reworked and reprepared to the satisfaction of the Contracting Officer before concrete is placed.

3.3 WEATHER LIMITATIONS

3.3.1 Placement and Protection During Inclement Weather

Do not commence placing operations when heavy rain or other damaging weather conditions appear imminent. At all times when placing concrete, maintain on-site sufficient waterproof cover and means to rapidly place it over all unhardened concrete or concrete that might be damaged by rain. Suspend placement of concrete whenever rain, high winds, or other damaging weather commences to damage the surface or texture of the placed unhardened concrete, washes cement out of the concrete, or changes the water content of the surface concrete. All unhardened concrete shall be immediately covered and protected from the rain or other damaging weather. Any slab damaged by rain or other weather shall be completely removed full depth, by full slab width, to the nearest original joint, and replaced at the Contractor's expense as specified in paragraph: REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS below.

3.3.2 Paving in Hot Weather

When the ambient temperature during paving is expected to exceed 90 degrees F, the concrete shall be properly placed and finished in accordance with procedures previously submitted, approved, and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C1064/C1064M. Cooling of the mixing water or aggregates or placing in the cooler part of the day may be required to obtain an adequate placing temperature. Steel forms and reinforcing shall be cooled as needed to maintain steel temperatures below 120 degrees F. Transporting and placing equipment shall be cooled or protected if necessary to maintain proper concrete placing temperature. The finished surfaces of the newly laid pavement shall be kept damp by applying a fog spray (mist) with approved spraying equipment until the pavement is covered by the curing medium.

Maximum Allowable Concrete Placing Temperature	
Relative Humidity, Percent, During Time of Concrete	Maximum Allowable Concrete Temperature in Degrees F
Greater than 60	95
40-60	85
Less than 40	80

3.3.3 Prevention of Plastic Shrinkage Cracking

During weather with low humidity, and particularly with high temperature and appreciable wind, develop and institute measures to prevent plastic shrinkage cracks from developing. If plastic shrinkage cracking occurs, halt further placement of concrete until protective measures are in place to prevent further cracking. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 4.2 of ACI 305R. In addition to the protective measures specified in the previous paragraph, the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. Apply monomolecular films after finishing is complete, do not use in the finishing process. When such water treatment is stopped, curing procedures shall be immediately commenced. Plastic shrinkage cracks that occur shall be repaired in accordance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.3.4 Paving in Cold Weather

Cold weather paving shall conform to ACI 306R. Special protection measures, as specified herein, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Placement of concrete shall not begin unless the ambient temperature is at least 35 degrees F and rising. Thereafter, placement of concrete shall be halted whenever the ambient temperature drops below 40 degrees F. When the ambient temperature is less than 50 degrees F, the temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer

shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. If allowed under paragraph: MIXTURE PROPORTIONS in PART 2, an accelerating admixture may be used when the ambient temperature is below 50 degrees F. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Remove pavement slabs damaged by freezing or falling below freezing temperature to full depth, by full slab width, to the nearest original joint, and replace at the Contractor's expense as specified in paragraph REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS.

3.4 CONCRETE PRODUCTION

Batching, mixing, and transporting equipment shall have a capacity sufficient to maintain a continuous, uniform forward movement of the paver of not less than 2.5 feet per minute. Concrete transported in non-agitating equipment shall be deposited in front of the paver within 45 minutes from the time cement has been charged into the mixing drum, except that if the ambient temperature is above 90 degrees F, the time shall be reduced to 30 minutes. Concrete transported in truck mixers shall be deposited in front of the paver within 90 minutes from the time cement has been charged into the mixer drum of the plant or truck mixer. If the ambient temperature is above 90 degrees F, the time shall be reduced to 60 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall be on approved forms and shall show at least the mass, or volume, of all ingredients in each batch delivered, and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government weekly, or as directed by the Contracting Officer.

3.4.1 Batching and Mixing Concrete

Scale pivots and bearings shall be kept clean and free of rust. Any equipment which fails to perform as specified shall immediately be removed from use until properly repaired and adjusted, or replaced.

3.4.2 Transporting and Transfer - Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. Concrete shall be deposited as close as possible to its final position in the paving lane. All equipment shall be operated to discharge and transfer concrete without segregation. In no case shall dumping of concrete in discrete piles be permitted. No transfer or spreading operation which requires the use of front-end loaders, dozers, or similar equipment to distribute the concrete will be permitted.

3.4.3 Slip Form Paving

When approved for use by the Contracting Officer, the slipform paver shall shape the concrete to the specified and indicated cross section in one pass, and shall finish the surface and edges so that only a very minimum amount of hand fishing is required.

3.5 PAVING

3.5.1 General Requirements

Pavement shall be constructed with paving and finishing equipment utilizing rigid fixed forms or by use of slipform paving equipment. Paving and finishing equipment and procedures shall be capable of constructing paving lanes of the required width at a rate of at least 2.5 feet of paving lane per minute on a routine basis. Paving equipment and its operation shall be controlled, and coordinated with all other operations, such that the paver-finisher has a continuous forward movement, at a reasonably uniform speed, from beginning to end of each paving lane, except for inadvertent equipment breakdown. Backing the paver and refinishing a lane is not permitted. Remove and replace concrete refinished in this manner. Failure to achieve a continuous forward motion requires halting operations, regrouping, and modifying operations to achieve this requirement. Workmen with foreign material on their footwear or construction equipment that might deposit foreign material shall not be permitted to walk or operate in the plastic concrete. Where an open-graded granular base is required under the concrete, select paving equipment and procedures which will operate properly on the base course without causing displacement or other damage.

3.5.2 Consolidation

Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches. Excessive vibration shall not be permitted. If the vibrators cause visible tracking in the paving lane, the paving operation shall be stopped and equipment and operations modified to prevent it. Concrete in small, odd-shaped slabs or in isolated locations inaccessible to the gang-mounted vibration equipment shall be vibrated with an approved hand-operated immersion vibrator operated from a bridge spanning the area. Vibrators shall not be used to transport or spread the concrete. Hand-operated vibrators shall not be operated in the concrete at one location for more than 20 seconds. Insertion locations for hand-operated vibrators shall be between 6 to 15 inches on centers. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) shall require the immediate stopping of the paving operation and approved adjustment of the equipment or procedures.

3.5.3 Operation

When the paver approaches a header at the end of a paving lane, a sufficient amount of concrete shall be maintained ahead of the paver to provide a roll of concrete which will spill over the header. The amount of extra concrete shall be sufficient to prevent any slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. The spud vibrators in front of the paver shall be brought as close to the header as possible before they are lifted. Additional consolidation shall be provided adjacent to the headers by hand-manipulated vibrators. When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement. Screeds or extrusion plates shall be

electronically controlled from the previously placed pavement so as to prevent them from applying pressure to the existing pavement and to prevent abrasion of the pavement surface. The overlapping area of existing pavement surface shall at all times be kept completely free of any loose or bonded foreign material as the paver-finisher operates across it. When the paver travels on existing pavement, approved provisions shall be made to prevent damage to the existing pavement. Pavers using transversely oscillating screeds shall not be used to form fill-in lanes that have widths less than a full width for which the paver was designed or adjusted.

3.5.4 Required Results

The paver-finisher, and its gang-mounted vibrators, together with its operating procedures shall be adjusted and operated and coordinated with the concrete mixture being used to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. The paver-finisher shall make only one pass across the pavement; multiple passes will not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing other than the use of cutting straightedges, except in very infrequent instances. If any equipment or operation fails to produce the above results, the paving shall be stopped, the equipment shall be replaced or properly adjusted, the operation shall be appropriately modified, or the mixture proportions modified, in order to produce the required results before recommencing paving. No water, other than fog sprays (mist) as specified in paragraph: Prevention of Plastic Shrinkage Cracking above, shall be applied to the concrete or the concrete surface during paving and finishing.

3.5.5 Fixed Form Paving

Paving equipment for fixed-form paving and the operation thereof shall conform to the requirements of paragraph EQUIPMENT, and all requirements specified herein.

3.5.5.1 Forms for Fixed-Form Paving

a. Straight forms shall be made of steel and shall be furnished in sections not less than 10 feet in length. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Wood forms for curves and fillets shall be made of well-seasoned, surfaced plank or plywood, straight, and free from warp or bend. Wood forms shall be adequate in strength and rigidly braced. Forms shall have a depth equal to the pavement thickness at the edge. Where the project requires several different slab thicknesses, forms may be built up by bolting or welding a tubular metal section or by bolting wood planks to the bottom of the form to completely cover the underside of the base of the form and provide an increase in depth of not more than 25 percent. The base width of the one-piece or built-up form shall be not less than eight-tenths of the vertical height of the form, except than forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Maximum vertical deviation of top of any side form, including joints, shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch.

b. Form sections shall be tightly locked and shall be free from play or movement in any direction. Forms shall be provided with adequate

devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.

c. Set forms for full bearing on foundation for entire length and width and in alignment with edge of finished pavement. Support forms during entire operation of placing, compaction, and finishing so that forms will not deviate vertically more than 0.01 foot from required grade and elevations indicated. Conformity to the alignment and grade elevations shown on the drawings shall be checked and necessary corrections shall be made immediately prior to placing the concrete. The forms shall be cleaned and oiled each time before concrete is placed. No concrete shall be placed until setting of forms has been checked and approved by the CQC team.

d. Do not anchor guide rails for fixed form pavers into new concrete or existing concrete to remain.

3.5.5.2 Form Removal

Keep forms in place at least 12 hours after the concrete has been placed. When conditions are such that the early strength gain of the concrete is delayed, leave the forms in place for a longer time, as directed. Remove forms by procedures that do not injure the concrete. Bars or heavy metal tools shall not be used directly against the concrete in removing the forms. Any concrete found to be defective after form removal shall be repaired promptly, using procedures specified or as directed.

3.5.6 Slipform Paving

3.5.6.1 General

Paving equipment for slipform paving and the operation thereof shall conform to the requirement of paragraph EQUIPMENT, and all requirements specified herein. The slipform paver shall shape the concrete to the specified and indicated cross section, meeting all tolerances, in one pass. The slipform paver shall finish the surface and edges so that only a very minimum isolated amount of hand finishing is required. If the paving operation does not meet the above requirements and the specified tolerances, immediately stop the operation, and regroup and replace or modify any equipment as necessary, modify paving procedures or modify the concrete mix, in order to resolve the problem. The slipform paver shall be automatically electronically controlled from a taut wire guideline for horizontal alignment and on both sides from a taut wire guideline for vertical alignment, except that electronic control from a ski operating on a previously constructed adjoining lane shall be used where applicable for either or both sides. Automatic, electronic controls for vertical alignment shall always be used on both sides of the lane. Control from a slope-adjustment control or control operating from the underlying material shall never be used. Side forms on slipform pavers shall be properly adjusted so that the finished edge of the paving lane meets all specified tolerances. Dowels in longitudinal construction joints shall be installed as specified below. The installation of these dowels by dowel inserters attached to the paver or by any other means of inserting the dowels into the plastic concrete shall not be permitted.

3.5.6.2 Guideline for Slipform Paving

Accurately and securely install guidelines well in advance of concrete

placement. Provide supports at necessary intervals to eliminate all sag in the guideline when properly tightened. The guideline shall be high strength wire set with sufficient tension to remove all sag between supports. Supports shall be securely staked to the underlying material or other provisions made to ensure that the supports will not be displaced when the guideline is tightened or when the guideline or supports are accidentally touched by workmen or equipment during construction. The appliances for attaching the guideline to the supports shall be capable of easy adjustment in both the horizontal and vertical directions. When it is necessary to leave gaps in the guideline to permit equipment to use or cross underlying material, provisions shall be made for quickly and accurately replacing the guideline without any delay to the forward progress of the paver. Supports on either side of the gap shall be secured in such a manner as to avoid disturbing the remainder of the guideline when the portion across the gap is positioned and tightened. The guideline across the gap and adjacent to the gap for a distance of 200 feet shall be checked for horizontal and vertical alignment after the guideline across the gap is tightened. Vertical and horizontal positioning of the guideline shall be such that the finished pavement shall conform to the alignment and grade elevations shown on the drawings within the specified tolerances for grade and smoothness. The specified tolerances are intended to cover only the normal deviations in the finished pavement that may occur under good supervision and do not apply to setting of the guideline. The guideline shall be set true to line and grade.

3.5.6.3 Laser Controls

If the Contractor proposes to use any type of automatic laser controls, submit a detailed description of the system and perform a trial field demonstration in the presence of the Contracting Officer at least one week prior to start of paving. Approval of the control system will be based on the results of the demonstration and on continuing satisfactory operation during paving.

3.5.7 Placing Reinforcing Steel

The type and amount of steel reinforcement shall be as shown on the drawings.

3.5.7.1 Pavement Thickness Greater Than 12 Inches

For pavement thickness of 12 inches or more, the reinforcement steel shall be installed by the strike-off method wherein a layer of concrete is deposited on the underlying material, consolidated, and struck to the indicated elevation of the steel reinforcement. The reinforcement shall be laid upon the prestruck surface, and the remaining concrete shall then be placed and finished in the required manner. When placement of the second lift causes the steel to be displaced horizontally from its original position, provisions shall be made for increasing the thickness of the first lift and depressing the reinforcement into the unhardened concrete to the required elevation. The increase in thickness shall be only as necessary to permit correct horizontal alignment to be maintained. Any portions of the bottom layer of concrete that have been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with newly mixed concrete without additional cost to the Government.

3.5.7.2 Pavement Thickness Less Than 12 Inches

For pavements less than 12 inches thick, the reinforcement shall be positioned on suitable chairs or continuous mesh support devices securely fastened to the subgrade prior to concrete placement. Concrete shall be vibrated after the steel has been placed. Regardless of placement procedure, the reinforcing steel shall be free from coatings which could impair bond between the steel and concrete, and laps in the reinforcement shall be as indicated. Regardless of the equipment or procedures used for installing reinforcement, ensure that the entire depth of concrete is adequately consolidated.

3.5.8 Placing Dowels and Tie Bars

The method used in installing and holding dowels in position shall ensure that the error in alignment of any dowel from its required horizontal and vertical alignment after the pavement has been completed will not be greater than 1/8 in. per ft. Except as otherwise specified below, horizontal spacing of dowels shall be within a tolerance of plus or minus 5/8 inch. The vertical location on the face of the slab shall be within a tolerance of plus or minus 1/2 inch). The vertical alignment of the dowels shall be measured parallel to the designated top surface of the pavement, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The horizontal alignment shall be checked with a framing square. Dowels and tie bars shall not be placed closer than 0.6 times the dowel bar tie bar length to the planned joint line. If the last regularly spaced longitudinal dowel is closer than that dimension, it shall be moved away from the joint to a location 0.6 times the dowel bar length, but not closer than 6 inches to its nearest neighbor. Dowel (tie bar) interference at a transverse joint-longitudinal joint intersection shall be resolved by deleting the closest transverse dowel (tie bar). Dowels shall be installed as specified in the following subparagraphs.

3.5.8.1 Contraction Joints

Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires. At the Contractor's option, in lieu of the above, dowels and tie bars in contraction joints shall be installed near the front of the paver by insertion into the plastic concrete using approved equipment and procedures. Approval will be based on the results of a preconstruction demonstration, showing that the dowels and tie bars are installed within specified tolerances.

3.5.8.2 Construction Joints-Fixed Form Paving

Install dowels and tie bars by the bonded-in-place method or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms. The spacing of dowels and tie bars in construction joints shall be as indicated, except that, where the planned spacing cannot be maintained

because of form length or interference with form braces, closer spacing with additional dowels or tie bars shall be used.

3.5.8.3 Dowels Installed in Hardened Concrete

Install dowels in hardened concrete by bonding the dowels into holes drilled into the hardened concrete. The concrete shall have cured for 7 days or reached a minimum compressive strength of 2500 psi before drilling commences. Holes 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur to the concrete joint face. Continuing damage shall require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of plus/minus 1/2 inch of the dimension shown on the drawings. Upon completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic grout retention ring fitted around the dowel. Dowels required to be installed in any joints between new and existing concrete shall be grouted in holes drilled in the existing concrete, all as specified above.

3.5.8.4 Lubricating Dowel Bars

The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed.

3.6 FINISHING

Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Any operations which produce more than 1/8 inch of mortar-rich surface (defined as deficient in plus U.S. No. 4 sieve size aggregate) shall be halted immediately and the equipment, mixture, or procedures modified as necessary. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way, except for fog (mist) sprays specified to prevent plastic shrinkage cracking.

3.6.1 Machine Finishing With Fixed Forms

The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

3.6.2 Surface Correction and Testing

After all other finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of cutting straightedges. Such straightedges shall be 12 feet in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated with an internal vibrator, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straightedge and conforms to the surface requirements specified in paragraph: ACCEPTABILITY OF WORK in PART 1. This straightedging shall not be used as a replacement for the straightedge testing of paragraph: Surface Smoothness in PART 1. Long-handled, flat bull floats shall be used very sparingly and only as necessary to correct minor, scattered surface defects. If frequent use of bull floats is necessary, the paving operation shall be stopped and the equipment, mixture or procedures adjusted to eliminate the surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Extreme care shall be taken to prevent overfinishing joints and edges. The surface finish of the pavement shall be produced essentially by the finishing machine and not by subsequent hand finishing operations. All hand finishing operations shall be subject to approval and shall be modified when directed.

3.6.3 Hand Finishing

Use hand finishing operations only as specified below.

3.6.3.1 Equipment and Template

In addition to approved mechanical internal vibrators for consolidating the concrete, provide a strike-off and tamping template and a longitudinal float for hand finishing. The template shall be at least 1 foot longer than the width of pavement being finished, of an approved design, and sufficiently rigid to retain its shape, and shall be constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 10 feet long, of approved design, and rigid and substantially braced, and shall maintain a plane surface on the bottom. Grate tampers (jitterbugs) shall not be used.

3.6.3.2 Finishing and Floating

As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. In addition to previously specified complete coverage with handheld immersion vibrators, the entire surface shall be tamped with the strike-off and tamping template, and the tamping operation continued until the required compaction and reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed, consolidated and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces.

3.6.4 Texturing

Before the surface sheen has disappeared and before the concrete hardens or curing compound is applied, the surface of the pavement shall be given a texture as described herein. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris.

3.6.4.1 Burlap Drag Surface

Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with an approved burlap drag. The drag shall be operated with the fabric moist, and the fabric shall be cleaned or changed as required to keep clean. The dragging shall be done so as to produce a uniform finished surface having a fine sandy texture without disfiguring marks.

3.6.4.2 Artificial Turf Drag Surface

Artificial turf texture shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf.

3.6.4.3 Broom Texturing

Brooming should be completed before the concrete has hardened to the point where the surface will be unduly torn or roughened, but after hardening has progressed enough so that the mortar will not flow and reduce the sharpness of the scores. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface. Brooms shall be washed thoroughly at frequent intervals during use. Worn or damaged brooms shall be removed from the job site. Hand brooming will be permitted only on isolated odd shaped slabs or slabs where hand finishing is permitted. For hand brooming, the brooms shall have handles longer than half the width of slab to be finished. The hand brooms shall be drawn transversely across the surface from the center line to each edge with slight overlapping strokes.

3.6.5 Edging

After texturing has been completed, the edge of the slabs along the forms, along the edges of slipformed lanes, and at the joints shall be carefully finished with an edging tool to form a smooth rounded surface of 1/8 inch

radius. Tool marks shall be eliminated, and the edges shall be smooth and true to line. No water shall be added to the surface during edging. Extreme care shall be taken to prevent overworking the concrete.

3.6.6 Outlets in Pavement

Recesses for the tie-down anchors, lighting fixtures, and other outlets in the pavement shall be constructed to conform to the details and dimensions shown. The concrete in these areas shall be carefully finished to provide a surface of the same texture as the surrounding area that will be within the requirements for plan grade and surface smoothness.

3.7 CURING

3.7.1 Protection of Concrete

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. If any selected method of curing does not afford the proper curing and protection against concrete cracking, the damaged pavement shall be removed and replaced, and another method of curing shall be employed as directed. Curing shall be accomplished by one of the following methods .

3.7.2 Membrane Curing

A uniform coating of white-pigmented, membrane-forming, curing compound shall be applied to the entire exposed surface of the concrete as soon as the free water has disappeared from the surface after finishing . Along the formed edge faces, it shall be applied immediately after the forms are removed. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water, and the curing compound applied as soon as the free water disappears. The curing compound shall be applied to the finished surfaces by means of an approved automatic spraying machine. The curing compound shall be applied with an overlapping coverage that will give a two-coat application at a coverage of 400 square feet per gallon, plus or minus 5.0 percent for each coat. A one-coat application may be applied provided a uniform application and coverage of 200 square feet per gallon, plus or minus 5.0 percent is obtained.The application of curing compound by hand-operated, mechanical powered pressure sprayers will be permitted only on odd widths or shapes of slabs and on concrete surfaces exposed by the removal of forms. When the application is made by hand-operated sprayers, a second coat shall be applied in a direction approximately at right angles to the direction of the first coat. If pinholes, abrasions, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be immediately resprayed. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.3 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, or until curing compound is applied, commencing immediately after finishing. If forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. Lap sheets to provide full coverage. Provide an approved work system to ensure that moist curing is continuous 24 hours per day and that the entire surface is wet.

3.8 JOINTS

3.8.1 General Requirements for Joints

Joints shall conform to the locations and details indicated and shall be perpendicular to the finished grade of the pavement. All joints shall be straight and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 1/2 inch. Where any joint fails to meet these tolerances, the slabs adjacent to the joint shall be removed and replaced at no additional cost to the Government. No change from the jointing pattern shown on the drawings shall be made without written approval of the Contracting Officer. Joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Joints shall be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

3.8.2 Longitudinal Construction Joints

Dowels or tie bars shall be installed in the longitudinal construction joints, or the edges shall be thickened as indicated. DowelsorTie bars shall be installed as specified above. After the end of the curing period, longitudinal construction joints shall be sawed to provide a groove at the top for sealant conforming to the details and dimensions indicated.

3.8.3 Transverse Construction Joints

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. The transverse construction joint shall be installed at a planned transverse joint. Transverse construction joints shall be constructed by utilizing headers or by paving through the joint, then full-depth sawcutting the excess concrete. Pavement shall be constructed with the paver as close to the header as possible, and the paver shall be run out completely past the header. Transverse construction joints installed at a planned transverse joint shall be constructed as shown or, if not shown otherwise, shall be dowelled in accordance with paragraph: Dowels Installed in Hardened Concrete, or paragraph: Fixed Form Paving above.

3.8.4 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using joint filler of the type, thickness, and width indicated, and shall be installed to form

a complete, uniform separation between the structure and the pavement. The filler shall be attached to the original concrete placement with adhesive or other fasteners and shall extend the full slab depth. After placement and curing of the adjacent slab, sawcut the sealant reservior depth from the filler. Adjacent sections of filler shall be fitted tightly together, and the filler shall extend across the full width of the paving lane or other complete distance in order to prevent entrance of concrete into the expansion space. Edges of the concrete at the joint face shall be finished with an edger with a radius of 1/8 inch.

3.8.5 Slip Joints

Slip joints shall be installed where indicated using the specified materials. Preformed joint filler material shall be attached to the face of the original concrete placement with adhesive or other fasteners. A 3/4 inch deep reservoir for joint sealant shall be constructed at the top of the joint. Edges of the joint face shall be finished with an edger with a radius of 1/8 inch.

3.8.6 Contraction Joints

Construct transverse and longitudinal contraction joints by sawing an initial groove in the concrete with a 1/8 inch blade to the indicated depth. During sawing of joints, and again 24 hours later, the CQC team shall inspect all exposed lane edges for development of cracks below the saw cut, and shall immediately report results to the Contracting Officer. If the Contracting Officer determines that there are more uncracked joints than desired, the Contractor will be directed to saw succeeding joints 25 percent deeper than originally indicated at no additional cost to the Government. The time of initial sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The sawed faces of joints will be inspected for undercutting or washing of the concrete due to the early sawing, and sawing shall be delayed if undercutting is sufficiently deep to cause structural weakness or excessive roughness in the joint. The sawing operation shall be carried on as required during both day and night regardless of weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. Adequate lighting shall be provided for night work. Illumination using vehicle headlights will not be permitted. A chalk line or other suitable guide shall be used to mark the alignment of the joint. Before sawing a joint, the concrete shall be examined closely for cracks, and the joint shall not be sawed if a crack has occurred near the planned joint location. Sawing shall be discontinued when a crack develops ahead of the saw cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water and vacuumed until all waste from sawing is removed from the joint and adjacent concrete surface. The surface shall be resprayed with curing compound as soon as free water disappears. Necessary precautions shall be taken to insure that the concrete is properly protected from damage and cured at sawed joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord backer rod before the concrete in the region of the joint is resprayed with curing compound, and shall be maintained until removed immediately before sawing the joint sealant reservoir. The exposed saw cuts on the faces of pilot lanes shall be sealed with bituminous mastic or masking tape. After expiration of the curing period, the upper portion of the groove shall be widened by sawing with ganged diamond saw blades to

the width and depth indicated for the joint sealer. The reservoir shall be centered over the initial sawcut.

3.8.7 Thickened Edge Joints

Construct thickened edge joints as indicated on the drawings. Underlying material in the transition area shall be graded as shown and shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

3.9 REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS

3.9.1 General Criteria

New pavement slabs that are broken, have spalled edges, or contain cracks shall be removed and replaced or repaired, as specified at no cost to the Government. Removal of partial slabs is not permitted. Not more than 15.0 percent of each slab's longitudinal joint edge shall be spalled. Prior to fill-in lane placement, pilot lane slabs with spalls exceeding this quantity, regardless of spall size, shall be sawn full depth to remove the spalled face. All other slabs shall be removed, as directed. The Contracting Officer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be at least 6 inch diameter, and shall be drilled and backfilled with an approved non-shrink concrete. Perform drilling of cores and refilling holes at no expense to the Government.

3.9.2 Slabs with Cracks

Clean cracks that do not exceed 2 inches in depth; then pressure injected full depth with epoxy resin, Type IV, Grade 1. Remove slabs containing cracks deeper than 2 inches.

3.9.3 Removal and Replacement of Full Slabs

Where it is necessary to remove full slabs, removal shall be in accordance with paragraph: Removal of Existing Pavement Slab below. Removal and replacement shall be full depth, by full width of the slab, and the limit of removal shall be normal to the paving lane and extend to each original joint. Dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified in paragraph PLACING DOWELS AND TIE BARS, above. Original damaged dowels or tie bars shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four edges of the new slab shall thus contain dowels. Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material shall be recompacted and shaped as specified in the appropriate section of these specifications, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels or tie bars. The resulting joints around the new slab shall be prepared and sealed as specified for original construction.

3.9.4 Repairing Spalls Along Joints

Where directed, spalls along joints of new slabs, along edges of adjacent existing concrete, and along parallel cracks shall be repaired by first

making a vertical saw cut at least 1 inch outside the spalled area and to a depth of at least 2 inches. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete and into at least 1/2 inch of visually sound concrete. Spalls along joints to be sealed with compression seals shall be sawn, chipped out, and repaired to a depth to restore the full joint-face support. The cavity thus formed shall be thoroughly cleaned with high pressure water jets supplemented with oil-free compressed air to remove all loose material. Immediately before filling the cavity, a prime coat shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Prime coat for portland cement repairs shall be a neat cement grout and for epoxy resin repairs shall be epoxy resin, Type III, Grade 1. The prepared cavity shall be filled with: Portland cement concrete or latex modified mortar for larger cavities, those more than 1/3 cu. ft. in size after removal operations; Portland cement mortar for cavities between 0.03 cu. ft. and 1/3 cu. ft.; and epoxy resin mortar or epoxy resin or latex modified mortar for those cavities less than 0.03 cu. ft. in size. Portland cement concretes and mortars shall be very low slump mixtures, 1/2 inch slump or less, proportioned, mixed, placed, consolidated by tamping, and cured, all as directed. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions and mixing and placing procedures as recommended by the manufacturer and approved by the Contracting Officer. Proprietary patching materials may be used, subject to approval by the Contracting Officer. The epoxy resin materials shall be placed in the cavity in layers not over 2 inches thick. The time interval between placement of additional layers shall be such that the temperature of the epoxy resin material does not exceed 140 degrees F at any time during hardening. Mechanical vibrators and hand tampers shall be used to consolidate the concrete or mortar. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints. The reservoir shall be thoroughly cleaned and then sealed with the sealer specified for the joints.

3.9.5 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Diamond grind slabs containing weak surfaces less than 1/4 inch thick to remove the weak surface. Diamond grinding shall be in accordance with paragraph DIAMOND GRINDING OF PCC SURFACES in PART 1. All ground areas shall meet the thickness, smoothness and grade criteria of paragraph ACCEPTANCE REQUIREMENTS in PART 1. Remove and replace slabs containing weak surfaces greater than 1/4 inch thick.

3.9.6 Repair of Pilot Lane Vertical Faces

Excessive edge slump and joint face deformation shall be repaired in accordance with paragraph EDGE SLUMP AND JOINT FACE DEFORMATION in PART 1. Inadequate consolidation (honeycombing or air voids) shall be repaired by saw cutting the face full depth along the entire lane length with a diamond blade. Obtain cores, as directed, to determine the depth of removal.

3.10 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR

Existing concrete pavement shall be removed at locations indicated on the drawings. Prior to commencing pavement removal operations, inventory the pavement distresses (cracks, spalls, and corner breaks) along the pavement edge to remain. After pavement removal, the remaining edge shall again be surveyed to quantify any damage caused by Contractor's removal operations. Perform both surveys in the presence of the Contracting Officer. Repairs shall be made as indicated and as specified herein. All operations shall be carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface, forming rectangular areas.

3.10.1 Removal of Existing Pavement Slab

When existing concrete pavement is to be removed and adjacent concrete is to be left in place, the joint between the removal area and adjoining pavement to stay in place shall first be cut full depth with a standard diamond-type concrete saw. Next, a full depth saw cut shall be made parallel to the joint at least 24 inches from the joint and at least 6 inches from the end of any dowels. This saw cut shall be made with a diamond saw as specified in paragraph: Sawing Equipment. All pavement to be removed beyond this last saw cut shall be removed in accordance with the approved demolition work plan. All pavement between this last saw cut and the joint line shall be removed by carefully pulling pieces and blocks away from the joint face with suitable equipment and then picking them up for removal. In lieu of this method, this strip of concrete may be carefully broken up and removed using hand-held jackhammers, 30 lb or less, or other approved light-duty equipment which will not cause stress to propagate across the joint saw cut and cause distress in the pavement which is to remain in place. In lieu of the above specified removal method, the slab may be sawcut full depth to divide it into several pieces and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and safe lifting devices used for attachment to the slab.

3.10.2 Edge Repair

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Slabs which are damaged during construction shall be removed and replaced as directed by the Contracting Officer at no cost to the Government. Repair of previously existing damage areas will be considered a subsidiary part of concrete pavement construction. All exposed keys and keyways shall be sawn off full depth.

3.10.2.1 Spall Repair

Not more than 15.0 percent of each slab's edge shall be spalled as a result of the Contractor's actions. Unless otherwise directed by the Contracting Officer, damaged slabs with spalls exceeding this quantity, regardless of spall size, shall be sawn full depth on the exposed face to remove the spalled face. Repair materials and procedures shall be as previously specified in paragraph: Repairing Spalls Along Joints.

3.10.2.2 Underbreak and Underlying Material

All underbreak shall be repaired by removal and replacement of the damaged slabs in accordance with paragraph: Removal and Replacement of Full Slabs

above. The underlying material adjacent to the edge of and under the existing pavement which is to remain in place shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient underlying material shall be kept in place outside the joint line to completely prevent disturbance of material under the pavement which is to remain in place. Any material under the portion of the concrete pavement to remain in place which is disturbed or loses its compaction shall be carefully removed and replaced with concrete.

3.11 PAVEMENT PROTECTION

Protect the pavement against all damage prior to final acceptance of the work by the Government. Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least 14 days old, or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected, the concrete has attained a minimum field cured flexural strength of 550 psi. and approved means are furnished to prevent damage to the slab edge. All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean, and spillage of concrete or other materials shall be cleaned up immediately upon occurrence. Special care shall be used where Contractor's traffic uses or crosses active airfield pavement. Power broom other existing pavements at least daily when traffic operates. For fill-in lanes, equipment shall be used that will not damage or spall the edges or joints of the previously constructed pavement.

3.12 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

3.12.1 Testing and Inspection by Contractor

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials (cement, GGBF and pozzolan), and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary for procurement of representative test samples. Furnish sampling platforms and belt templates to obtain representative samples of aggregates from charging belts at the concrete plant. Samples of concrete shall be obtained at the point of delivery to the paver. Testing by the Government will in no way relieve the Contractor of the specified testing requirements. Perform the inspection and tests described below, and based upon the results of these inspections and tests, take the action required and submit reports as required. This testing shall be performed regardless of any other testing performed by the Government, either for pay adjustment purposes or for any other reason.

3.12.2 Testing and Inspection Requirements

Contractor CQC sampling, testing, inspection and reporting shall be in accordance with the following Table.

TABLE 6
CONTRACTOR TESTING AND INSPECTION REQUIREMENTS

Frequency	Test Method	Control Limit	Corrective Action
Fine Aggregate Gradation and Fineness Modulus			
2 per lot	ASTM C136 sample at belt	9 of 10 tests vary <0.15 from average	
		Outside limits on any sieve	Retest
		2nd failure	Stop, repair, retest
Coarse Aggregate Gradation			
2 per lot	ASTM C136 sample at belt	Outside limits on any sieve	Retest
		2nd failure	report to COR, correct
		2 consecutive avgs of 5 tests out	report to COR, stop ops, repair, retest
Workability Factor and Coarseness Factor Computation			
Same as C.A. and F.A.	see paragraph AGGREGATES	Use individual C.A. and F.A. gradations. Combine using batch ticket percentages. Tolerances: +/- 3 points on WF; +/- 5 points on CF from approved mix design values	Check batching tolerances, recalibrate scales
Aggregate Deleterious, Quality, and ASR Tests			
Every 30 days	see paragraph AGGREGATES		Stop production, retest, replace aggregate. Increase testing interval to 90 days if previous 2 tests pass
Plant - Scales, Weighing Accuracy			
Monthly	NRMCA QC 3		Stop plant ops, repair, recalibrate
Plant - Batching and Recording Accuracy			
Weekly	Record/Report	Record required/recorded/actua batch mass	Stop plant ops, repair, recalibrate
Plant - Batch Plant Control			
Every lot	Record/Report		Record type/amt of each material per lot

TABLE 6
CONTRACTOR TESTING AND INSPECTION REQUIREMENTS

Frequency	Test Method	Control Limit	Corrective Action
Plant - Mixer Uniformity - Stationary Mixers			
Every 4 months during paving	COE CRD-C 55	After initial approval, use abbreviated method	Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest
Plant - Mixer Uniformity - Truck Mixers			
Every 4 months during paving	ASTM C94/C94M	Random selection of truck.	Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest
Concrete Mixture - Air Content			
When test specimens prepared + 2 random	ASTM C231/C231M sample at paving site	Individual test control chart: Warning +/-1.0	Adjust AEA, retest
		Individual test control chart: Action +/-1.5	Halt operations, repair, retest
		Range between 2 consecutive tests: Warning +2.0	Recalibrate AEA dispenser
		Range between 2 consecutive tests: Action +3.0	Halt operations, repair, retest
Concrete Mixture - Unit Weight and Yield			
Same as Air Content	ASTM C138/C138M sample at paving site	Individual test basis: Warning Yield -0/+1 percent	Check batching tolerances
		Individual test basis: Action Yield -0/+5 percent	Halt operations
Concrete Mixture - Slump			
When test specimens prepared + 4 random	ASTM C143/C143M sample at paving site	Individual test control chart: Upper Warning - 1/2 inch below max	Adjust batch masses within max W/C ratio
		Individual test control chart: Upper Action - maximum allowable slump	Stop operations, adjust, retest
		Range between each consecutive test: 1-1/2 inches	Stop operations, repair, retest

TABLE 6 CONTRACTOR TESTING AND INSPECTION REQUIREMENTS			
Frequency	Test Method	Control Limit	Corrective Action
Concrete Mixture - Temperature			
When test specimens prepared	ASTM C1064/C106 sample at paving site	See paragraph WEATHER LIMITATIONS	
Concrete Mixture - Strength			
8 per lot	ASTM C31/C31M sample at paving station	See paragraph CONCRETE STRENGTH TESTING for CQC	
Paving - Inspection Before Paving			
Prior to each paving operation	Report	Inspect underlying materials, construction joint faces, forms, reinforcing, dowels, and embedded items	
Paving - Inspection During Paving			
During paving operation		Monitor and control paving operation, including placement, consolidation, finishing, texturing, curing, and joint sawing.	
Paving - Vibrators			
Weekly during paving	COE CRD-C 521	Test frequency (in concrete), and amplitude (in air), measure at tip/head and average.	Repair or replace defective vibrators.
Moist Curing			
2 per lot, min 4 per day	Visual		Repair defects, extend curing by 1 day
Membrane Compound Curing			
Daily	Visual	Calculate coverage based on quantity/area	Respray areas where coverage defective. Recalibrate equipment
Cold Weather Protection			
Once per day	Visual		Repair defects, report conditions to

3.12.3 Concrete Strength Testing for Contractor CQC

Contractor Quality Control operations for concrete strength shall consist of the following steps:

a. Take samples for strength tests at the paving site. Fabricate and cure test cylinders in accordance with ASTM C31/C31M; test them in accordance with ASTM C39/C39M.

b. Fabricate and cure 2 test cylinders per sublot from the same batch or truckload and at the same time acceptance cylinders are fabricated and test them for compressive strength at 7-day age.

c. Average all 8 compressive tests per lot. Convert this average 7-day compressive strength per lot to equivalent 28-day flexural strength using the Correlation Ratio determined during mixture proportioning studies.

d. Compare the equivalent 28-day flexural strength from the conversion to the Average Flexural Strength Required for Mixtures from paragraph of same title.

e. If the equivalent average 28-day strength for the lot is below the Average Flexural Strength Required for Mixtures by 20 psiflexural strength or more, at any time, adjust the mixture to increase the strength, as approved.

f. Fabricate and cure two beams for every 2000 cubic yards of concrete placed. Fabricate and cure in accordance with ASTM C31/C31M; test at 14-days of age in accordance with ASTM C78/C78M. Use the flexural strength results to verify the cylinder-beam acceptance correlation ratio.

g. The Contractor's CQC testing agency shall maintain up-to-date control charts for strength, showing the 7-day CQC compressive strength, the 14-day compressive strength (from acceptance tests) and the 28-day equivalent flexural strength of each of these for each lot.

3.12.4 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. Prepare a weekly report for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, make daily reports of pertinent temperatures. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor quality control records.

-- End of Section --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 32 17 23.00 20

PAVEMENT MARKINGS
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 the basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325	(Rev D; Notice 1) Beads (Glass Spheres) Retro-Reflective (Metric)
FS TT-P-1952	(Rev E) Paint, Traffic and Airfield Markings, Waterborne

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. 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

Reflective media for airfields

Paints for airfields

Equipment; G

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Qualifications

Documentation on personnel qualifications, as specified.

SD-06 Test Reports

Reflective media for airfields

Paints for airfields

Certified reports from sampling and testing made in accordance with paragraph entitled "Sampling and Testing" prior to the use of the materials at the jobsite. Testing shall be performed in an

approved independent laboratory.

SD-07 Certificates

Reflective media for airfields

Paints for airfields

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

Construction equipment list

SD-08 Manufacturer's Instructions

Paints for airfields

Submit manufacturer's Material Safety Data Sheets.

1.3 DELIVERY AND STORAGE

Deliver paints and paint materials in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer. Provide storage facilities at the job site, only in areas approved by the Contracting Officer or authorized representative, for maintaining materials at temperatures recommended by the manufacturer.

1.4 WEATHER LIMITATIONS

Apply paint to clean, dry surfaces, and unless otherwise approved, only when the air and pavement surface temperature is at least 5 degrees above the dew point and the air and pavement temperatures are above 40 degrees F and less than 95 degrees F for oil-based materials; above 50 degrees F and less than 110 degrees F for water-based materials. Maintain paint temperature within these same limits.

1.5 EQUIPMENT

Machines, tools, and equipment used in the performance of the work shall be approved by the Contracting Officer and maintained in satisfactory operating condition. Submit construction equipment list for approval by the Contracting Officer.

1.5.1 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

1.5.2 Paint Application Equipment

1.5.2.2 Self-Propelled or Mobile-Drawn Pneumatic Spraying Machines

The equipment for applying the paint for airfield pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with an

arrangement of atomizing nozzles capable of applying a width of line at any one time in multiples of 6 inches from 6 to 36 inches at a speed of at least 5 miles per hour. Provide paint applicator with paint reservoirs or tanks of sufficient capacity and suitable gages to apply paint in accordance with requirements specified. Equip tanks with suitable air-driven mechanical agitators. Equip spray mechanism with quick-action valves conveniently located, and include necessary pressure regulators and gages in full view and reach of the operator. Install paint strainers in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Provide pneumatic spray guns for hand application of paint in areas where the mobile paint applicator cannot be used. Applicator for water-based markings shall be equipped with non-stick coated hoses; metal parts in contact with the paint material shall be constructed of grade 302, 304, 316, or equal stainless steel.

1.5.4 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.5.6 Surface Preparation Equipment

1.5.6.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked. Water will be furnished at no cost to the Contractor from a fire hydrant designated by the Contracting Officer or authorized representative and located within a reasonable proximity to the work area. The Contractor shall install a gate valve and a back-flow prevention device on the fire hydrant tap. The Contractor shall furnish all equipment, material, and labor required to obtain and deliver water from the designated fire hydrant to the work area(s).

1.5.7 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.5.7.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradable residue.

1.6 MAINTENANCE OF TRAFFIC

1.6.1 Airfield

The performance of work in the controlled zones of airfields shall be coordinated with the Contracting Officer and with the Flight Operations Officer. Verbal communications shall be maintained with the control tower before and during work in the controlled zones of the airfield. The control tower shall be advised when the work is completed. A radio for this purpose shall be provided by the Contractor and approved by the Contracting Officer.

1.6.2 Lighting

When night operations are necessary, all necessary lighting and equipment shall be provided. Lighting shall be directed or shaded to prevent interference with aircraft, the air traffic control tower, and other base operations. All lighting and related equipment shall be capable of being removed from the runway within 15 minutes of notification of an emergency. Night work must be coordinated with the Airfield Manager and approved in advance by the Contracting Officer or authorized representative. The Government reserves the right to accept or reject night work on the day following night activities by the Contractor.

1.7 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

1.8 QUALIFICATIONS

The Contractor shall submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials conforming to the requirements specified herein.

2.1.1 Paints for Airfields

FS TT-P-1952, color as indicated.

2.1.3 Reflective Media for Airfields

FS TT-B-1325, Type III, Gradation A.

2.1.4 Preformed Thermoplastic Airport Pavement Markings

Markings must be composed of ester modified resins in conjunction with aggregates, pigments, and binders that have been factory produced as a finished product. The material must be impervious to degradation by aviation fuels, motor fuels, and lubricants.

a. The markings must be able to be applied in temperatures as low as 35°F without any special storage, preheating, or treatment of the material before application.

(1) The markings must be supplied with an integral, non-reflectorized black border.

b. Graded glass beads

(1) The material must contain a minimum of 30% intermixed graded glass beads by weight. The intermixed beads shall conform to Federal Specification TT-B-1325D, Type IV gradation B.

(2) The material must have factory applied coated surface beads in addition to the intermixed beads at a rate of one (1) lb (0.45 kg) (±10%) per 10 square feet (1 sq m). These factory applied coated surface beads shall have a minimum of 90% true spheres, minimum refractive index of 1.50, and meet the following gradation.

Size Gradation			
U.S. Mesh	um	Retained, Percent	Passing, Percent
12	1700	0 - 2	98 - 100
14	1400	0 - 3.5	96.5 - 100
16	1180	2 - 25	75 - 98
18	1000	28 - 63	37 - 72
20	850	63 - 72	28 - 37
30	600	67 - 77	23 - 33
50	300	89 - 95	5 - 11
80	200	97 - 100	0 - 3

c. Heating indicators. The material manufacturer shall provide a method to indicate that the material has achieved satisfactory adhesion and proper bead embedment during application and that the installation procedures have been followed.

d. Pigments. Percent by weight.

(1) White: Titanium Dioxide, ASTM D476, type II shall be 10% minimum.

(2) Yellow and Colors: Titanium Dioxide, ASTM D476, type II shall be 1% minimum. Organic yellow, other colors, and tinting as required to meet color standard.

e. Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

f. Daylight directional reflectance.

(1) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(2) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 45% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the Federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x .462	x .470	x .479	x .501
y .438	y .455	y .428	y .452

g. Skid resistance. The surface, with properly applied and embedded surface beads, must provide a minimum resistance value of 45 BPN when tested according to ASTM E303.

h. Thickness. The material must be supplied at a nominal thickness of 65 mil.

i. Environmental resistance. The material must be resistant to deterioration due to exposure to sunlight, water, salt, or adverse weather conditions and impervious to aviation fuels, gasoline, and oil.

j. Retroreflectivity. The material, when applied in accordance with manufacturer's guidelines, must demonstrate a uniform level of nighttime retroreflection when tested in accordance to ASTM E1710.

k. Packaging. Packaging shall protect the material from environmental conditions until installation.

l. Preformed thermoplastic airport pavement marking requirements.

(1) The markings must be a resilient thermoplastic product with uniformly distributed glass beads throughout the entire cross-sectional area. The markings must be resistant to the detrimental effects of aviation fuels, motor fuels and lubricants, hydraulic fluids, deicers, anti-icers, protective coatings, etc. Lines, legends, and symbols must be capable of being affixed to asphalt and/or Portland cement concrete pavements by the use of a large radiant heater. Colors shall be available as required.

(2) The markings must be capable of conforming to pavement contours, breaks, and faults through the action of airport traffic at normal pavement temperatures. The markings must be capable of fully conforming to grooved pavements, including pavement grooving per advisory circular (AC) 150/5320-12, current version. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastics when heated with a heat source per manufacturer's recommendation.

(3) Multicolored markings must consist of interconnected individual pieces of preformed thermoplastic pavement marking material, which through a variety of colors and patterns, make up the desired design. The individual pieces in each large marking segment (typically more than 20 feet long) must be factory assembled with a compatible material and interconnected so that in the field it is not necessary to assemble the individual pieces within a marking segment. Obtaining multicolored effect by overlaying materials of different colors is not acceptable due to resulting inconsistent marking thickness and inconsistent application temperature in the marking/substrate interface.

(4) The marking material must set up rapidly, permitting the access route to be re-opened to traffic after application.

(5) The marking material shall have an integral color throughout the thickness of the marking material.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Allow new pavement surfaces to cure for a period of not less than 30days before application of marking materials. Thoroughly clean surfaces to be marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required. Remove existing paint markings, residual curing compounds, and other coatings adhering to the pavement according to the removal requirements and procedures outlined in Section 32 01 11.51. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application. After cleaning oil-soaked areas, seal with shellac or primer recommended by the manufacturer to prevent bleeding through the new paint. Do not commence painting in any area until pavement surfaces are dry and clean.

3.1.2 Early Painting of Asphalt Pavements

For asphalt pavement systems requiring painting application at less than 30 days, apply the paint and beads at half the normal application rate, followed by a second application at the normal rate after 30 days.

3.2 APPLICATION

3.2.1 Testing for Moisture

Apply pavement markings to dry pavement only. The Contractor shall test the pavement surface for moisture before beginning work after each period of rainfall, fog, high humidity, or cleaning, or when the ambient temperature has fallen below the dew point. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the CO or authorized representative. Employ the "plastic wrap method" to test the pavement for moisture as follows: Cover the pavement with a 300 mm by 300 mm (12 inch by 12 inch) section of clear plastic wrap and seal the edges with tape. After 15 minutes, examine the plastic wrap for any visible moisture accumulation inside the plastic. Do not begin marking operations until the test can be performed with no visible moisture accumulation inside the plastic wrap.

3.2.2 Rate of Application

3.2.2.1 Reflective Markings

Apply paint evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet per gallon. Apply glass spheres uniformly to the wet paint on airfield pavement at a rate of (10) plus or minus (0.5) pounds of glass spheres per gallon. Collect and record readings for white and yellow retroreflective markings at the rate of one reading per 1000 linear feet. The minimum acceptable average for white markings is 200 millicandelas per square meter per lux (mcd/m2/lx) (measured with Mirolux 12 Retroreflectometer or similar instrument as agreed). The minimum acceptable average for yellow markings is 175 millicandelas per square meter per lux (mcd/m2/lx). Readings shall be computed by averaging a minimum of 10 readings taken within the area at random locations. Areas not meeting the retroreflective requirements stated above shall be re-marked.

3.2.2.2 Nonreflective Markings

Apply paint evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.

3.2.3 Painting

Apply paint pneumatically with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Discontinue painting operations if there is a deficiency in drying of the markings until cause of the slow drying is determined and corrected.

3.2.4 Reflective Media

Application of reflective media shall immediately follow the application of paint. Accomplish drop-on application of the glass spheres to ensure even distribution at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, discontinue operations until deficiency is corrected.

3.3 FIELD TESTING, INSPECTION, AND DEMONSTRATIONS

3.3.1 Sampling and Testing

As soon as the paint and reflective materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch in the presence of the Contracting Officer. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved. Test samples by an approved laboratory. If a sample fails to meet specification, replace the material in the area represented by the samples and retest the replacement material as specified above. Submit copy of the test results to the

Contracting Officer. Include in the report of test results a listing of any specification requirements not verified by the test laboratory.

3.3.2 Inspection

Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. A certificate of compliance shall be accompanied by test results substantiating conformance to the specified requirements.

3.3.3 Surface Preparations and Application Procedures

Surface preparations and application procedures will be examined by the Contracting Officer to determine conformance with the requirements specified. Approve each separate operation prior to initiation of subsequent operations.

3.3.3.1 Surface Preparation Demonstration

Prior to surface preparation, demonstrate surface preparation using the proposed materials, methods and equipment according to the procedures outlined in Section 32 01 11.51. Prepare areas large enough to determine cleanliness and rate of cleaning.

3.3.3.2 Test Stripe Demonstration

Prior to paint application, demonstrate test stripe application within the work area using the proposed materials and equipment. Apply separate test stripes in each of the line widths and configurations required herein using the proposed equipment. The test stripes shall be long enough to determine the proper speed and operating pressures for the vehicle(s) and machinery, but not less than 50 feet long.

3.3.3.3 Application Rate Demonstration

During the Test Stripe Demonstration, demonstrate compliance with the application rates specified herein. Document the equipment speed and operating pressures required to meet the specified rates in each configuration of the equipment and provide a copy of the documentation to the Contracting Officer or authorized representative 14 days prior to proceeding with the work.

3.3.3.4 Retroreflective Value Demonstration

After the test stripes have cured to a "no-track" condition, demonstrate compliance with the average retroreflective values specified herein. Take a minimum of ten readings on each test stripe with a Mirolux 12 Retroreflectometer, or similar instrument with the same measuring geometry and direct readout in millicandelas per square meter per lux (mcd/m2/lx).

3.3.3.5 Level of Performance Demonstration

The Contracting Officer or authorized representative will be present the application demonstrations to observe the results obtained and to validate the operating parameters of the vehicle(s) and equipment. If accepted by the Contracting Officer or authorized representative, the test stripe shall be the measure of performance required for this project. Work shall not proceed until the demonstration results are satisfactory to the Contracting Officer or authorized representative.

3.4 TRAFFIC CONTROL AND PROTECTION

Place warning signs near the beginning of the work site and well ahead of the work site for alerting approaching traffic from both directions. Place small markers along newly painted lines to control traffic and prevent damage to newly painted surfaces. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation. Do not use foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power lines.

3.5 QUALITY ASSURANCE

Demonstrate success of bond of reflective media, new paint marking and the pavement surface, vacuum cured surface of new marking after a seven (7) day dry time. Inspect newly applied markings for signs of bond failure based on visual inspection and comparison to results from Test Stripe Demonstration paragraph.

3.5.1 Reflective Media and Coating Bond Verification

Within seven (7) days after pavement marking application, use industrial vacuum to sweep new markings. Visually inspect the pavement markings and the material captured by the vacuum. Verify that no significant loss of reflective media has occurred to the pavement marking due to the vacuum cleaning.

3.5.2 Reflective Media and Coating Application Verification

Use a wet film thickness gauge to measure the application of wet paint.

Use a microscope or magnifying glass to evaluate the embedment of glass beads in the paint. Verify the glass bead embedment with approximately 50 percent of the beads embedded and 50 percent of the beads exposed.

-- 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.

ASTM INTERNATIONAL (ASTM)

ASTM C 602	(2007) Agricultural Liming Materials
ASTM D 4427	(2007) Peat Samples by Laboratory Testing
ASTM D 4972	(2001; R 2007) pH of Soils

TURFGRASS PRODUCERS INTERNATIONAL (TPI)

TPI GSS	(1995) Guideline Specifications to Turfgrass Sodding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

100 percent ground cover of Cynodon dactylon, Common Bermuda Grass.

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. 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, Gypsum, Sulfur, 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, gypsum, sulfur, 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, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit or is below 50 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.

2.1.2 Purity

Sod species shall be genetically pure, free of weeds, pests, and disease.

2.1.3 Planting Dates

Lay sod from March to September.

2.1.4 Composition

2.1.4.1 Proportion

Sod shall be 100% (Bermuda) Eynodon dactylon.

2.3 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."

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.

2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D 4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	25-50 percent
Clay	5-20 percent
Sand	40-60 percent
pH	5.5 to 6.5
Soluble Salts	600 ppm maximum

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.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D 4427. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 91 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.10 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.5 FERTILIZER

2.5.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

16 percent available nitrogen
4 percent available phosphorus
8 percent available potassium

2.6 WATER

Unless otherwise directed, the source of water shall be the responsibility of the Contractor and shall be approved by the Contracting Officer. Source of water shall be of non-potable or potable and of suitable quality for irrigation, containing no elements 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

Provide 4 inches of off-site topsoil or on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters, and soil conditioners 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 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.1.2.2 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site.

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.

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.

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 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 --

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 33 71 02

UNDERGROUND ELECTRICAL DISTRIBUTION
02/15

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 CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI SP-66	(2004) ACI Detailing Manual

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8	(2007) specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B496	(2014) Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C478	(2014) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C857	(2014) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM F2160	(2010) Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 400.2	(2013) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)

IEEE 404	(2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE 48	(2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2011) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI/NEMA WC 71/ICEA S-96-659	(1999) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 7	(2013) Standard for Smooth-Wall Coilable Electrical Polyethylene Conduit
NEMA WC 74/ICEA S-93-639	(2012) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758	(2012b) Customer-Owned Outside Plant

Telecommunications Infrastructure Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644	(2002) Underground Plant Construction

UNDERWRITERS LABORATORIES (UL)

UL 1072	(2006; Reprint Jun 2013) Medium-Voltage Power Cables
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2013; Reprint Feb 2014) Wire Connectors
UL 510	(2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013) Metallic Outlet Boxes
UL 514B	(2012; Reprint Nov 2014) Conduit, Tubing and Cable Fittings
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 651	(2011; Reprint May 2014) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 83	(2014) Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Reprint Nov 2014) Standard for Service-Entrance Cables
UL 94	(2013; Reprint Sep 2014) Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 SYSTEM DESCRIPTION

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast underground structures; G

SD-03 Product Data

Medium voltage cable; G

Medium voltage cable joints; G

Medium voltage cable terminations; G

Precast concrete structures; G

Sealing Material

Pulling-In Irons

Manhole frames and covers; G

Handhole frames and covers; G,

Frames and Covers for Airfield Facilities; G

Ductile Iron Frames and Covers for Airfield Facilities; G

Composite/fiberglass handholes; G

Cable supports (racks, arms and insulators); G

SD-06 Test Reports

Medium voltage cable qualification and production tests; G

Field Acceptance Checks and Tests; G

Arc-proofing test for cable fireproofing tape; G

Cable Installation Plan and Procedure; G

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. Separate sections 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

Cable splicer/terminator; G

Cable Installer Qualifications; G, _____

Directional Boring Certificate of Conformance; G, _____

1.4 QUALITY ASSURANCE

1.4.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings in accordance with ACI SP-66

e. Plans and elevations showing opening and pulling-in iron locations and details

1.4.2 Certificate of Competency for Cable Splicer/Terminator

The cable splicer/terminator must have a certification from the National Cable Splicing Certification Board (NCSCB) in the field of splicing and terminating shielded medium voltage (5 kV to 35 kV) power cable using pre-manufactured kits (pre-molded, heat-shrink, cold shrink). Submit "Proof of Certification" for approval, for the individuals that will be performing cable splicer and termination work, 30 days before splices or terminations are to be made.

1.4.3 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers. Cable installer must demonstrate experience with a minimum of three medium voltage cable installations. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for an alternate qualified cable installer.

1.4.4 Directional Boring Certificate of Conformance

Provide certification of compliance with the registered Professional Engineer's design requirements for each directional bore, including: HDPE conduit size and type, bend radius, elevation changes, vertical and horizontal path deviations, conductor size and type and any conductor derating due to depth of conduit. Record location and depth of all directional-bore installed HDPE conduits using Global Positioning System (GPS) recording means with "resource grade" accuracy.

1.4.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" 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 must be in accordance with the mandatory and advisory provisions of IEEE C2 and 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 must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for 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 must 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 are not acceptable, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.1.1 Rigid Metallic Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness must be nominal 85 Shore A durometer, dielectric strength must be minimum 400 volts per mil at 60 Hz, and tensile strength must be minimum 3500 psi.

2.1.2 Intermediate Metal Conduit

UL 1242.

2.1.2.1 Intermediate Metal Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness must be nominal 85 Shore A durometer, dielectric strength must be minimum 400 volts per mil at 60 Hz,

and tensile strength must be minimum 3500 psi.

2.1.3 Plastic Conduit for Direct Burial and Riser Applications

UL 651 and NEMA TC 2, EPC-40.

2.1.4 Plastic Duct for Concrete Encasement

Provide Type EPC-40 per UL 651 and NEMA TC 2.

2.1.5 High Density Polyethylene (HDPE) Electrical Conduit for Directional Boring

Smoothwall, approved/listed for directional boring, minimum Schedule 80, ASTM F2160, NEMA TC 7.

2.1.6 Duct Sealant

UL 94, Class HBF. Provide high-expansion urethane foam duct sealant that expands and hardens to form a closed, chemically and water resistant, rigid structure. Sealant must be compatible with common cable and wire jackets and capable of adhering to metals, plastics and concrete. Sealant must be capable of curing in temperature ranges of 35 degrees F to 95 degrees F. Cured sealant must withstand temperature ranges of -20 degrees F to 200 degrees F without loss of function.

2.1.7 Fittings

2.1.7.1 PVC Conduit Fittings

UL 514B, UL 651.

2.1.7.2 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit must be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and must conform to UL 514A.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors must be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements. Wires and cables manufactured more than 24 months prior to date of delivery to the site are not acceptable. Service entrance conductors must conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller must be solid. Conductors No. 8 AWG and larger must be stranded. All conductors must be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, must be 600-volt, Type THWN/THHN conforming to UL 83. Copper conductors must be annealed copper complying with ASTM B3 and ASTM B8.

2.2.3 Jackets

Multiconductor cables must have an overall PVC outer jacket.

2.2.4 Direct Buried

Single-conductor and multi-conductor cables must be of a type identified for direct burial.

2.2.5 In Duct

Cables must be single-conductor cable.

2.2.6 Cable Marking

Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Identify each cable 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 must contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors must be color coded. Provide conductor identification within each enclosure where a tap, splice, or termination is made. Conductor identification must be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves,or colored electrical tape. Control circuit terminations must be properly identified. Color must 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 neutrals must be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems must 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

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Must provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors 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 with ANSI C119.1.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

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 must not require heat or flame, or any additional materials such as covering or adhesive. It must be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 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 must 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 24 months prior to date of delivery to the site are not acceptable. Provide single conductor type cables unless otherwise indicated.

2.5.1 Cable Configuration

Provide Type MV cable, conforming to NEMA WC 74/ICEA S-93-639 and UL 1072. Provide cables manufactured for use in duct applications as indicated. Cable must be rated 5 kV with 133 percent insulation level.

2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B conductors. Provide soft drawn copper cables complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding.

2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of ANSI/NEMA WC 71/ICEA S-96-659 and insulation .

2.5.4 Shielding

Cables rated for 2 kV and above must have a semiconducting conductor shield, a semiconducting insulation shield, and an overall coppershield for each phase.

2.5.5 Neutrals

Neutral conductors must be copper, employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.

2.5.6 Jackets

Provide cables with a PVCjacket.

2.6 MEDIUM VOLTAGE CABLE TERMINATIONS

IEEE 48 Class 1; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. 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, where required, must be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Terminations must be provided in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and installation. Terminations must be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Cold-Shrink Type

Terminator must be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber. Termination must not require heat or flame for installation. Termination kit must contain all necessary materials (except for the lugs). Termination must be designed for installation in low or highly contaminated indoor and outdoor locations and must resist ultraviolet rays and oxidative decomposition.

2.6.2 Heat Shrinkable Type

Terminator must 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. Termination must be designed for installation in low or highly contaminated indoor or outdoor locations.

2.7 MEDIUM VOLTAGE CABLE JOINTS

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, insulation type, and construction of the cable. Joints must be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint must be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2.7.1 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.

2.7.2 Cold-Shrink Rubber-Type Joint

Joint must be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket must be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice must be packaged three splices per kit, including complete installation instructions.

2.8 TAPE

2.8.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.8.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

2.8.3 Fireproofing Tape

Provide tape composed of a flexible, conformable, unsupported intumescent elastomer. Tape must be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, adhesive-free, and must not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.9 PULL ROPE

Plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.10 GROUNDING AND BONDING

2.10.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.10.2 Grounding Conductors

Stranded-bare copper conductors must conform to ASTM B8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors must conform to ASTM B1 for sizes No. 8 and smaller. Insulated conductors must be of the same material as phase conductors and green color-coded, except that conductors must be rated no more than 600 volts. Aluminum is not acceptable.

2.11 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. In addition, provide concrete for encasement of underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts must be 4000 psi minimum 28-day compressive strength unless specified otherwise.

2.12 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types conforming to ASTM C857 and ASTM C478. Top, walls, and bottom must consist of reinforced concrete. Walls and bottom must be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers must fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings must be free from warp and blow holes that may impair strength or appearance. Exposed metal must have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, must be adequate to accommodate the cable.

2.13 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms must be zinc-coated after fabrication.

2.13.1 Cable Rack Stanchions

The wall bracket or stanchion must be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, or 4 inches by approximately 1 inch glass-reinforced nylon with recessed bolt mounting holes, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms must be spaced at 8 inch intervals.

2.13.2 Rack Arms

Cable rack arms must be steel or malleable iron or glass reinforced nylon and must be of the removable type. Rack arm length must be a minimum of 8 inches and a maximum of 12 inches.

2.13.3 Insulators

Insulators for metal rack arms must be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.14 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags must be polyethylene. Do not provide handwritten letters. The first position on the power cable tag must denote the voltage. The second through sixth positions on the tag must identify the circuit. The next to last position must denote the phase of the circuit and include the Greek "phi" symbol. The last position must denote the cable size. 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.

2.14.1 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 must have a minimum loop tensile strength of 175 pounds. The cable tags must have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols must not fall off or change positions regardless of the cable tags' orientation.

2.15 PROTECTIVE DEVICES AND COORDINATION

2.16 SOURCE QUALITY CONTROL

2.16.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer must test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing tape per manufacturer's instructions. The arc and fireproofing tape must withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode must be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc must be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly must be tested at three unrelated points. Start time for tests must be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time must be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape must indicate that the test has been performed and passed by the manufacturer.

2.16.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS8 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758 and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Inspect each cable reel for correct storage positions, signs of physical

damage, and broken end seals prior to installation. If end seal is broken, remove moisture from cable prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

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 limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. Perform pulling calculations and prepare a pulling plan and submit along with the manufacturer's instructions in accordance with SUBMITTALS. Install cable strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

Calculations and pulling plan must 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 bearing 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.

3.4 Field Painting

Cast-iron frames and covers not buried in concrete or masonry must be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

3.5 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.5.1 Requirements

Run conduit in straight lines except where a change of direction is necessary. Provide numbers and sizes of ducts as indicated. Provide a 4/0 AWG bare copper grounding conductor below medium-voltage distribution duct banks. Bond bare copper grounding conductor to ground rings (loops) in all manholes and to ground rings (loops) at all equipment slabs (pads). Route

grouding conductor into manholes with the duct bank (sleeving is not required). Ducts must have a continuous slope downward toward underground structures and away from buildings, 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. Provide ducts with end bells whenever duct lines terminate in structures.

Perform changes in ductbank direction as follows:

a. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable.

b. The minimum manufactured bend radius must be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter.

c. As an exception to the bend radius required above, provide field manufactured longsweep bends having a minimum radius of 25 feet for a change of direction of more than 5 degrees, either horizontally or vertically, using a combination of curved and straight sections. Maximum manufactured curved sections: 30 degrees.

3.5.2 Treatment

Ducts must be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers must be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer must be used whenever an existing duct is connected to a duct of different material or shape. Ducts must be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts must be thoroughly cleaned before being laid. Plastic ducts must be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Conduit Cleaning

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.

3.5.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, must be zinc-coated, rigid steel, jacked into place. Where ducts are jacked under existing pavement, rigid steel conduit must 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 must be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers.

3.5.5 Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations must be PVC coated and must extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.5.6 Multiple Conduits

Separate multiple conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly must consist of base spacers, intermediate spacers, ties, and locking device on top 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.

3.5.7 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty must be provided with plugs on each end. Plugs must 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.

3.5.8 Conduit and Duct Without Concrete Encasement

Depths to top of the conduit must be not less than 24 inches below finished grade. Provide not less than 3 inches clearance from the conduit to each side of the trench. 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. The first 6 inch layer of backfill cover must be sand compacted as previously specified. The rest of the excavation must be backfilled and compacted in 3 to 6 inch layers. Provide color, type and depth of warning tape as specified in Section 31 23 00.00 20 EXCAVATION AND FILL31 00 00 EARTHWORK.

3.5.8.1 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 must 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. Depths to top of the concrete envelope must be not less than 24 inches below finished grade.

3.5.8.2 Directional Boring

HDPE conduits must be installed below the frostline and as specified herein.

For distribution voltages greater than 1000 volts and less than 34,500 volts, depths to the top of the conduit must not be less than 48 inches in pavement-covered areas and not less than 120 inches in non-pavement-covered areas. For branch circuit wiring less than 600 volts, depths to the top of the conduit must not be less than 24 inches in pavement- or non-pavement-covered areas.

3.5.9 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Depths to top of the concrete envelope must be not less than 18 inches below finished grade, except under roads and pavement, concrete envelope must be not less than 24 inches below finished grade. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank must be rectangular in cross-section and must provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring must be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape as specified in Section indicated.

3.5.9.1 Connections to Manholes

Duct bank envelopes connecting to underground structures must be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section must 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 must 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.

3.5.9.2 Connections to Existing Underground Structures

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 extend into 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.

3.5.9.3 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. Remove existing cables which constitute interference with the work.

3.5.9.4 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 foot apart. Restrain reinforcing assembly from moving during concrete pouring.

3.5.9.5 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.

3.5.10 Duct Sealing

Seal all electrical penetrations for radon mitigation, maintaining integrity of the vapor barrier, and to prevent infiltration of air, insects, and vermin.

3.6 CABLE PULLING

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 must 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.

3.6.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.7 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, 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. 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.

3.7.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. 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.

3.8 CONDUCTORS INSTALLED IN PARALLEL

Conductors must 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.

3.9 LOW VOLTAGE CABLE SPLICING AND TERMINATING

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.

3.10 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

3.11 MEDIUM VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

3.11.1 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 the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods must be as specified elsewhere in this section. Wire must be trained to the sides of the enclosure to prevent interference with the working area.

3.12 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.12.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.12.2 Tape-Wrap

Tape-wrap metallic-sheathed or metallic armored cables without a nonmetallic protective covering over the sheath or armor prior to application of fireproofing. Wrap must be in the form of two tightly applied half-lapped layers of a pressure-sensitive 10 mil thick plastic tape, and must 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.

3.13 GROUNDING SYSTEMS

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

3.13.1 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.
If the specified ground resistance is not met, an additional ground rod must be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined)

resistance exceed the specified resistance, measured not less than 48 hours after rainfall, notify the Contracting Officer immediately.

3.13.2 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 must be as recommended by the manufacturer. An embossing die code or other standard method must provide visible indication that a connector has been adequately compressed on the ground wire.

3.13.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.13.4 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.

3.13.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

3.14 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 23 00.00 20 EXCAVATION AND FILL31 00 00 EARTHWORK.

3.14.1 Reconditioning of Surfaces

3.14.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct . 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, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

3.14.1.2 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. Make repairs as specified in Section .

3.15 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.15.1 Concrete Slabs (Pads) for Equipment

Unless otherwise indicated, the slab must 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 must be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab must be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade must have 1/2 inch chamfer. Slab must 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.

3.15.2 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals must be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.16 FIELD QUALITY CONTROL

3.16.1 Performance of Field 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.

3.16.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

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) Visually inspect jacket and insulation condition.

(7) 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 acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests must be very low frequency (VLF) alternating voltage withstand tests in accordance with IEEE 400.2. VLF test frequency must be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages must be as follows:

CABLE RATING AC TEST VOLTAGE for ACCEPTANCE TESTING	
5 kV	10kV rms(peak)
8 kV	13kV rms(peak)
15 kV	20kV rms(peak)
25 kV	31kV rms(peak)
35 kV	44kV rms(peak)

CABLE RATING AC TEST VOLTAGE for MAINTENANCE TESTING	
5 kV	7kV rms(peak)
8 kV	10kV rms(peak)
15 kV	16kV rms(peak)
25 kV	23kV rms(peak)
35 kV	33kV rms(peak)

3.16.1.2 Low Voltage Cables, 600-Volt

Perform tests after installation of cable, splices and terminations and before terminating to equipment or splicing to existing circuits.

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) Verify tightness of accessible bolted electrical connections.

(4) Inspect compression-applied connectors for correct cable match and indentation.

(5) Visually inspect jacket and insulation condition.

(6) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 1000 volts dc for one minute.

(2) Perform continuity tests to insure correct cable connection.

3.16.1.3 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE 81. 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 resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument must 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. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance.

3.16.2 Follow-Up Verification

Upon completion of acceptance checks and tests, 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 must be given 5 working days advance notice of the dates and times of checking and testing.

.... -- End of Section --

SECTION 34 43 00.00 20

AIRFIELD LIGHTING
02/10

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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C603	(2004; R 2008) Extrusion Rate and Application Life of Elastomeric Sealants
ASTM C639	(2001; R 2011) Rheological (Flow) Properties of Elastomeric Sealants
ASTM C661	(2006; R 2011) Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
ASTM C679	(2003; E 2009; R 2009) Tack-Free Time of Elastomeric Sealants
ASTM C719	(2013) Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
ASTM C792	(2004; R 2008) Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants
ASTM C793	(2005; R 2010) Effects of Accelerated Weathering on Elastomeric Joint Sealants
ASTM D412	(2006a; R 2013) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D709	(2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code

IEEE C62.11	(2012) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1kV)
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LA 1	(2009) Standard for Surge Arresters
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2013) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA TC 6 & 8	(2013) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
NEMA WC 3	(1992; Rev 1 1994) Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013;Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
NFPA 70B	(2013) Recommended Practice for Electrical Equipment Maintenance

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 345-67	(1998) REA Specification for Filled Telephone Cables, PE-39

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-P-8944	(1970; Rev A; Am 1 1983; Notice 2) Panel,

	Airport Lighting Control, General Specification for
MIL-STD-461	(2007; Rev F) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-T-27535	(1964; Rev A; Supp 1 1964; Am 2 1965; Notice 1 1993; Notice 3 1999) Transformer, Power, Isolation, Series Circuit, Airport Lighting, General Specification for
MS 17814	(1972; Rev C; Am 1 2002; Notice 1 2006; Notice 2 2012) Coupling, Frangible, Aviation Ground Lights

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 150/5345-10	(2005; Rev F) Specification for Constant Current Regulators Regulator Monitors
FAA AC 150/5345-13	(2007; Rev B) Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
FAA AC 150/5345-26	(2008; Rev D) FAA Specification for L-823 Plug and Receptacle, Cable Connectors
FAA AC 150/5345-27	(2013; Rev E) Specification for Wind Cone Assemblies
FAA AC 150/5345-28	(2005; Rev F) Precision Approach Path Indicator (PAPI) Systems
FAA AC 150/5345-42	(2013; Rev G) Specification for Airport Light Bases, Transformer Housings, Junction Boxes and Accessories
FAA AC 150/5345-44	(2007; Rev H) Specification for Runway and Taxiway Signs
FAA AC 150/5345-46	(2009; Rev D) Specification for Runway and Taxiway Light Fixtures
FAA AC 150/5345-47	(2005; Rev B) Specification for Series to Series Isolation Transformers for Airport Lighting Systems
FAA AC 150/5345-5	(2006; Rev B) Specification for Airport Lighting Circuit Selector Switch
FAA AC 150/5345-51	(2005; Rev A) Specification for Discharge-Type Flashing Light Equipment
FAA AC 150/5345-7	(2013; Rev F) Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
FAA AC 150/5370-10	(2009; Rev E) Standards for Specifying

	Construction of Airports
FAA E-2756	(2004; Rev B) Four Box Precision Approach Path Indicator (PAPI) without Remote Monitoring Subsystem (RMS)
FAA E-982	(2003; Rev J) PAR-56 Lampholder

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-200	(Rev E; Am 1; Notice 1) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2012) Standard for Flexible Metal Conduit
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 360	(2013; Reprint May 2013) Liquid-Tight Flexible Steel Conduit
UL 44	(2010) Thermoset-Insulated Wires and Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 514A	(2013) Metallic Outlet Boxes
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 6A	(2008; Reprint May 2013) Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel
UL 854	(2004; Reprint Nov 2014) Standard for Service-Entrance Cables

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

SD-02 Shop Drawings

SD-03 Product Data

Materials and Equipment

Protection Plan

SD-06 Test Reports

Field Quality Control

Counterpoise system test

Visual Inspection

SD-07 Certificates

Installer Qualifications; G

Construction Outage Plan; G

Materials and Equipment

SD-10 Operation and Maintenance Data

Constant current regulators, Data Package 5

Submit in accordance with Section 01 78 23.00 25 OPERATION AND MAINTENANCE DATA.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

Do not install materials which are not approved as "Approved Airport Equipment" by FAA unless specifically approved by the electrical design engineer. Inspect wire and cable for date of manufacture. Do not use wire and cable manufactured more than one year before delivery to job site.

1.3.2 Regulatory Requirements

Provide materials and equipment listed by FAA, UL, ETL or approved by Factory Mutual Engineering and Research (FM), when such equipment is listed or approved. Do not use askarel, tetrachlorethylene and insulating liquids containing polychlorinated biphenyls (PCBs) in equipment. Provide submersible type equipment installed below grade in vaults, manholes, and handholes. Materials must be certified and listed as "Approved Airport Lighting Equipment" downloadable from: http://www.faa.gov/arp/pdf/534553ad.pdf.

1.3.3 Installer Qualifications

The aviation lighting equipment contractor and installation electricians must be experienced in installing, testing and maintaining aviation lighting systems of a similar complexity. The contractor must provide a list of government projects and qualified management personnel with at least 3 years of experience in constructing similar projects. Include written certification that systems have performed satisfactorily for not less than 18 months.

1.3.4 Construction Outage Plan

The contractor must provide a construction outage plan and schedule for installing new and retrofitting the existing lighting system to ensure that aviation lighting circuits are fully operational between dusk and dawn during each day of the construction contract. The plan must be submitted to and approved by the Contracting Officer and the Airfield Manager prior to starting construction.

1.3.5 Protection Plan

Submit detailed procedures to prevent damage to existing facilities or infrastructures. If damage does occur, the procedures shall address repair and replacement of damaged property at the Contractor's expense.

1.3.6 Prevention of Corrosion

1.3.6.1 Ferrous Metal Hardware

Ferrous metal hardware shall be hot-dip, galvanized in accordance with ASTM A 123/A 123M and ASTM A 153/A 153M.

1.4 EXTRA MATERIALS

1.4.1 Oil Fuses

Provide one spare fuseholder and three spare fuses for each ampere size.

1.4.2 REIL Flashing Light System

Provide a spare part trunk with parts.

1.5 EQUIPMENT

1.5.1 Equipment for Silicone Sealant

Equipment for silicone sealant shall be air-powered pump, components, and hoses as recommended by the sealant manufacturer. Hoses and seals shall be lined to prevent moisture penetration and withstand pumping pressures. Equipment shall be free of contamination from previously used other type sealant.

PART 2 PRODUCTS

2.1 2.1 MATERIALS AND EQUIPMENT

Provide materials 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.

a. Submit a complete itemized listing of equipment and materials proposed for incorporation into the work. Each itemization shall include an item number, the quantity of items proposed, and the name of the manufacturer.

b. Submit data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

c. When equipment or materials are specified to conform to the standards or publications and requirements of AASHTO, ANSI, ASTM, AEIC, FM, IEEE, IES, NEMA, NFPA, or UL, or to an FAA, FS, or MS, submit proof that the items furnished under this section conform to the specified requirements.

d. The label or listing in UL Electrical Construction or in FM APP GUIDE or the manufacturer's certification or published catalog specification
data statement that the items comply with applicable specifications, standards, or publications and with the manufacturer's standards will be acceptable evidence of such compliance.

e. Certificates shall be prepared by the manufacturer when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

2.2 NAMEPLATES

Provide laminated plastic nameplates for equipment, controls, and devices to identify function, and where applicable, position. Provide 1/8 inch thick laminated Melamine plastic conforming to ASTM D709, Grade ES-2, white with black center core. Surface shall be a matte finish with square corners. Align and engrave lettering accurately into the black core. Size of nameplates shall be one by 2 1/2 inches minimum with minimum 1/4 inch high normal block lettering. 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.

2.3 CONDUIT, CONDUIT FITTINGS, AND BOXES

2.3.1 Rigid Steel or Intermediate Metal Conduit (IMC) and Fittings

UL 6, UL 6A and UL 1242, respectively, coated with a polyvinylchloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1.

2.3.2 Flexible Metal Conduit

UL 1, zinc-coated steel. Use UL 360 liquid-tight flexible metal conduit in wet locations.

2.3.3 Outlet Boxes for Use with Steel Conduit, Rigid or Flexible

UL 514A, cast metal with gasketed closures.

2.3.4 Plastic Duct for Concrete Encased Burial

PVC conforming to NEMA TC 6 & 8, Type EB.

2.3.5 Plastic Conduit for Direct Burial

PVC conforming to NEMA TC 2 (conduit) and NEMA TC 3 (fittings), Type EPC-40 PVC.

2.3.6 Frangible Couplings and Adapters

MS 17814. Provide upper section of frangible coupling with one of the following:

a. Unthreaded for slip-fitter connections.

b. 2 13/32 inch: 16N-1A modified thread for nut and compression ring to secure 2 inch EMT.

c. 2 inch: 11 1/2-N.P.T. (tapered) with 7/32-inch nominal wall thickness to accept rigid conduit coupling.

2.3.6.1 Frangible Couplings for Specialized Applications

Acceptable as approved.

2.3.6.2 Electrical Metallic Tubing

UL 797. Provide where indicated for use with frangible couplings and adapters.

2.4 WIRE AND CABLE

Do not provide or install wire and cable manufactured more than one year before delivery to the job site. Conductors shall be copper.

2.4.1 Conductor Sizes

Conform to American Wire Gage (AWG).

2.4.2 Low Voltage Wire and Cable

UL 854, Type USE, 600 volts for underground low voltage power cables.UL 44, Type XHHW for secondary series lighting circuits. Provide wire with "W" in the type designation in wet or damp locations.

2.4.3 Power Cables for Use in Airfield Lighting

Rated 5 kV, 133 percent insulation level, with shield and jacket conforming to NEMA WC 7 for crosslinked polyethylene insulated cables.

2.4.4 Wire and Cable for Airfield Lighting Systems

2.4.4.1 Airfield Lighting Cable

FAA AC 150/5345-7, Type L-824, for crosslinked polyethylene Type C 5000 -volt cable. Series airfield lighting cable shall be unshielded. Airfield lighting cable in multiple power airfield circuits shall be unshielded.

2.4.4.2 Cable for Pavement Slot Installation

UL 44, Type XHHW.

2.4.4.3 Counterpoise Wire

ASTM B3, ASTM B8. No. 4 AWG bare stranded copper, annealed or soft drawn.

2.4.4.4 Control Cable

Multiconductor type for 120 V ac control, rated 600 volts, No. 12 AWG, and conforming to the following unless indicated or specified otherwise. Insulate each conductor with a thickness of not less than 30 mils and rate for continuous operation at 90 degrees C. Conductors shall be color coded. An overall jacket of heavy-duty neoprene rated for direct burial shall be included. Cable shall conform to NEMA WC 3for rubber insulation, NEMA WC 7 for cross-linked polyethylene insulation, or NEMA WC 8 for ethylene-propylene rubber insulation. Multiconductor type for 48 V dc control, rated 300 volts, No. 19 AWG, conforming to RUS Bull 345-67.

2.4.4.5 Fused Cable Connectors

Provide connector consisting of a line side receptacle and a load side plug, each in a molded rubber form and including crimp-on fittings for the cable ends to accommodate a 250-volt cartridge-type fuse. Provide fuse with rating indicated. Provide connectors in kit form properly sized for the specific cable diameter involved. Completed connection shall be watertight.

2.4.4.6 Cable for Sequence Flashing Trigger Circuits

RUS Bull 345-67.

2.4.5 Cable Tags

Provide cable tags for each cable or wire at duct entrances entering or leaving of manholes, handholes, and at each terminal within the lighting vault. Provide stainless steel, bronze, lead strap, or copper strip tags approximately 1/16 inch thick or hard plastic 1/8 inch thick suitable for immersion in salt water and impervious to petroleum products. Provide sufficient length for imprinting the legend on one line using raised letters not less than 1/4 inch in size. Permanently mark or stamp with the identification as directed. Two-color laminated plastic is acceptable. P lastic tags shall be yellow with black engraved lettering to provide contrast so that identification can be easily read. Provide fastening material of a type that will not deteriorate when exposed to water with a high saline content and petroleum products.

2.4.6 Concrete Markers for Direct Buried Cable Systems

Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.5 GROUND RODS

UL 467. 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 indicated otherwise.

2.6 Lighting Arresters

Lighting arrestors shall be in accordance with IEEE C62.11, IEEE C62.41.1.

2.7 Surge Protections

Surge protection shall be metal oxide varistors (MOV) in accordance with NEMA LA 1 for power and signal circuits with ratings as recommended by the

system manufacturer.

2.8 INTERNALLY LIGHTED WIND CONE

FAA AC 150/5345-27, Type L-807, with a rigid support assembly, lighted internally with L.E.D. lamps, and an orange 12 foot fabric cone. Provide wiring and controls. Supplemental wind cones, where used, shall be Type L-806.

2.9 RUNWAY DISTANCE MARKERS

Runway distance markers shall conform to FAA AC 150/5345-44, Type L-858B, Size 4, Style 3 with white or yellow numerals on a black background. Provide markers to withstand a static wind load of 0.28 pound per square inch, and suitable for connection to the secondary of the isolation transformers specified. Provide internally illuminated markers with illumination of the face not significantly decreasing when the series lighting circuit is operated at the lowest brightness step. Construct marker housing of fiber reinforced epoxy, with information face of high-impact acrylic or ultraviolet stabilized polycarbonate.

2.10 TRANSFORMERS

2.10.1 Encapsulated Isolating Transformers

FAA AC 150/5345-47, Type (G) L-830 or MIL-T-27535. Provide each transformer with rating as indicated. Insulation Level Primary voltage rating 5000 volts RMS, Secondary 600 V RMS. Operating Temperature range minus 55 degrees Celsius to plus 65 degrees Celsius. Resistant to UV exposure and ozone. Suitable for areas contaminated with oils, aircraft fuels, soil acids, alkalis, and deicing fluids. Compatible with FAA Style 2 and Style 9 connectors.

2.10.2 Power Transformers

These transformers shall be in accordance with IEEE C57.12.50 as indicated.

2.11 LIGHT BASES

FAA AC 150/5345-42 Type L-867 and L-868. Provide steel bases, Class 1, Size as indicated or as required to accommodate the fixture or device installed thereon if diameter is not shown.

2.11.1 Accessories

Provide base plates, cover plates, and adapter plates to accommodate various sizes of fixtures. Bolts shall be stainless steel.

2.12 SEALING FIXTURES AND WIRES IN DRILLED HOLES OR SAW KERFS

FAA AC 150/5370-10, Type P-606.

2.12.1 Sealant Type

FAA Type P-606 sealant for use in asphaltic concrete (AC) or Portland cement concrete (PCC) pavement compatible with AC pavement and having a minimum elongation of 50 percent. Formulations of Type P-606 which are compatible with PCC pavement only are prohibited.

2.12.2 Single Component Cold-Applied Silicone

Silicone sealant shall be self-leveling, non-acid curing, and meet the following requirements.

TEST	TEST METHOD	REQUIREMENTS
Weight Loss	ASTM C792 Modified (See Note 1)	10 percent max.
Flow	ASTM C639 (Type I)	Smooth and level
Extrusion Rate	ASTM C603	30 sec. max.
Tack Free Time	ASTM C679	5 hours max.
Hardness (Shore 00) (See Note 2)	ASTM C661	30 - 80
Tensile Stress at 150 Percent Elongation (See Note 2)	ASTM D412 (Die C)	30 psi max.
Percent Elongation (See Note 2)	ASTM D412 (Die C)	700 min.
Accelerated Weathering	ASTM C793	Pass 5000 hours
Bond and Movement Capability	ASTM C719	Pass 10 cycles at plus 50 percent movement (no adhesion or cohesion failure)
Flame Resistant	FS SS-S-200	Pass
NOTES: 1. Percent weight loss of wet (uncured) sample after placing in forced-draft oven maintained at 158 degrees F plus 1 degree F for two hours.		
2. Specimen cured 21 days at 73 degrees F plus 1 degree F and 50 percent.		
ACCELERATED WEATHERING FACTORY TEST REPORT. For Accelerated Weathering test, in lieu of testing of actual joint sealant to be used on the project, a report of a factory test, performed within two years of contract award, may be submitted.		

2.13 CONSTANT CURRENT REGULATORS

FAA AC 150/5345-10, Type L-828, without monitor system and with ratings as indicated.

2.13.1 Regulator

Regulators shall operate on 60 Hz, have internal primary switch included, have input voltage of 480 and be controlled by 120-volt external control voltage. Provide three and five brightness steps as indicated. Provide monitors as indicated.

2.13.2 Basic Impulse Level (BIL)

Provide 60-kV series circuit BIL except that 4-kW, 7.5-kW and 10-kW regulator series circuits may have a BIL of 25 kV.

2.14 LAMPS AND FILTERS

Provide lamps of size and type indicated, or required by fixture manufacturer for each lighting fixture required under this contract. Provide filters as indicated and conforming to the specification for the light concerned or to the standard referenced.

2.15 CIRCUIT SELECTOR CABINETS

FAA AC 150/5345-5, Type L-847, for circuit control as indicated, Class A, indoor, Rating 1, for 6.6 amp.

2.16 PILOT RELAY PANEL

MIL-P-8944 for 120-volt control (L) systems, . FAA AC 150/5345-13, Type L-841, for 48-V dc control systems.

2.17 CONTROL TRANSFER PANEL

Transfer panel, 120-volt, 60 Hz, with eight-pole, double-throw, continuous-duty, industrial control type relay, in NEMA Type 1 enclosure. Relay contacts shall have a rating of not less than 10 amp for continuous noninductive loads.

2.18 CONTROL PANEL

MIL-P-8944, Class 1. Quantity and color of lenses shall conform to MIL-P-8944 and shall correspond to the actual circuits indicated.

2.19 RUNWAY AND TAXIWAY LIGHTING SYSTEMS

Include LED runway edge lights, LED runway threshold lights, LED taxiway guidance signs at intersecting taxiway and intersecting runways LED runway distance markers, LED taxiway edge lights,LED taxiway guidance signs, mounting structures, controls, and the associated equipment and interconnecting wiring to provide complete systems as indicated and specified herein. Provide inpavement light fixtures able to withstand a minimum static single wheel load of 50,000 pounds.

2.19.1 Runway Edge Lights

FAA AC 150/5345-46, Type L-862(L) , for elevated mounting; and
FAA AC 150/5345-46, Type L-850 (L) Class C, for semiflush mounting at intersecting taxiways, at intersecting runways and adjacent to arresting gear. Provide filters as indicated conforming to requirements of fixture specifications.

2.19.2 Runway Threshold Lights

Elevated FAA E-982 for mounting outboard of edge lights; and FAA AC 150/5345-46, Type L-862(L), for elevated mounting inboard of edge lights.

2.19.3 Runway End Identification Lights (REIL)

FAA AC 150/5345-51, Type L-849, Style E. Provide master and slave fixtures and power and control equipment. The REIL units shall be an FFA approved LED type and shall flash in unison twice per second.

2.19.4 Taxiway Edge Lights

FAA AC 150/5345-46, Type L-861T(L) for elevated taxiway edge lights with 6.6A lamp and blue lens or yellow lens as indicated.

2.19.5 Taxiway Guidance Signs

FAA AC 150/5345-44. Informational signs Type L-858Y(L) and mandatory signs Type L-858R. Provide size as indicated. Provide series circuit power supply adapters approved by the sign manufacturer.

2.20 CONNECTORS

FAA AC 150/5345-26, FAA Type L-823 connectors for use with FAA Type L-824 airfield lighting cable.

2.21 PRECISION APPROACH PATH INDICATOR (PAPI)

Consists of four light units mounted in the area of the ground point of intercept of the glide slope and aimed in the direction of the approach.

2.21.1 Light Units

FAA AC 150/5345-28, Type L-880 or FAA E-2756. Connect light units to series current circuits via appropriate isolation transformers as recommended by the system manufacturer. Provide tilt switches and relays to de-energize all light units when one unit exceeds tilt requirements.

PART 3 EXECUTION

3.1 ELECTRICAL REQUIREMENTS

Electrical installation shall conform to IEEE C2, NFPA 70, NFPA 70B and requirements specified herein. Underground electrical work shall be as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION SYSTEM.

3.1.1 Electrical Metallic Tubing

Do not install underground or encase in concrete.

3.2 CONCRETE

Unless otherwise specified, provide 3000 psi concrete for below grade and 4000 psi concrete for above grade use with one inch maximum aggregate conforming to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3 AIRFIELD MANHOLES AND HANDHOLES

Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION SYSTEM.

3.4 EARTHWORK

Provide excavation, backfilling, and reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION SYSTEM.

3.5 GROUNDING

Ground non-current carrying metallic parts associated with electrical equipment as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.6 CABLE MARKERS

Provide cable markers or tags for each cable at duct entrances entering or leaving manholes or handholes and at each termination within the lighting vault. Tag cables in each manhole or handhole with not less than two tags per cable, one near each duct entrance hole. Immediately after cable installation, permanently attach tags to cables and wires so that they cannot be accidentally detached.

3.7 FRANGIBLE REQUIREMENTS

Install frangible supports, couplings, and adapters as indicated and specified. Install with the type conduit indicated.

3.8 ELEVATED AIRFIELD LIGHTS

Frangibly mount normally not exceeding 14 inches in height unless higher mounting is permitted in snow accumulation areas. Frangibly mount equipment exceeding 14 inches in height as indicated.

3.9 SEMIFLUSH AIRFIELD LIGHTS

Remove water, debris, and other foreign substances prior to installing semiflush light base and light.

3.10 WIRES, FIXTURES, AND ENCLOSURES IN SAW KERFS OR DRILLED HOLES

Sealant is specified in paragraph entitled "Sealing Fixtures and Wires in Drilled Holes or Saw Kerfs."

3.10.1 Holes for Light Fixtures

Bore holes in pavement to dimensions indicated. Use a diamond-edged bit to provide a smooth, straight cut. Bottom of hole shall be flat or slightly concave, except that an area at least one inch wide around the perimeter shall be flat. Fill surfaces deeper than the prescribed depth with sealant to the level of the flat area and allow to cure before further placement.

3.10.2 Holes for Transformer Enclosures

Drill holes through concrete pavement and remove loose material. Fill hole with concrete to depth indicated. Provide a minimum of 3 inches of concrete at bottom of hole.

3.10.3 Sandblasting

Sandblast saw kerfs, grooves, and holes to remove foreign or loose material. Accomplish sandblasting by using approved equipment maintained in good working order at all times. Provide sand used for blasting of the proper size and quality as necessary to perform the work. Provide nozzles used for sandblasting of the proper size in relation to the groove or holes to be cleaned. Replace nozzles enlarged by wear as necessary. Sandblast at an air pressure of not less than 90 psi.

3.10.4 Cleaning

Immediately prior to installation of wire or light fixtures, flush saw kerfs and holes with a high velocity water jet or steam, and clean and dry with a high velocity air jet to remove dirt and foreign material.

3.10.5 Lighting Fixture Installation

Sandblast sides and bottom of each light fixture immediately prior to installation. Cover inside faces of bored hole and bottom and sides of light fixture with a coating of sealant that will completely fill the void between concrete and fixture. Use a jig or holding device for installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Orient light fixture with light beam parallel to flight deck centerline or runway centerline and facing in the particular direction required. Level outermost edge of fixture with the surrounding pavement. Remove surplus sealant or flexible embedding material. Leave the holding device in place until sealant has reached its initial set. Properly arrange fixture lead wires with respect to their connecting position. Block the wire way entrance into the light recess to retain the sealant material during curing.

3.11 SPLICES FOR AIRFIELD LIGHTING CABLE

3.11.1 Connectors

Use kit type connectors to splice 5 kV single-conductor series lighting cables. During installation and prior to covering with earth, keep mating surfaces of connectors covered until connected and clean when plugged together. At joint where connectors come together, and install heat shrinkable tubing with waterproof sealant at the ends of the heat shrink tubing. the Contractor shall provide two half lapped layers of high voltage splicing tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.12 GROUNDING SYSTEMS

3.12.1 Counterpoise Installation

Lay counterpoise wire for entire length of circuits supplying airfield lighting. Provide wire in one piece, except where distance exceeds the length usually supplied, and install on top of the envelope of concrete-encased duct or granulate backfill material and approximately 6 inches above direct burial cables and duct lines unless indicated otherwise. Where trenches or duct lines intersect, electrically interconnect counterpoise wires by exothermic welding. Connect counterpoise wires together and to existing counterpoise wires. Connect counterpoise to earth ground at every 500 feet of cable run, at lighting vault, and at feeder

connection to light circuit by means of ground rods as specified.

3.12.2 Fixture Grounding

Ground each fixture or group of adjacent fixtures to a separate ground system. Do not connect fixture grounding to the trench counterpoise system. Connect fixtures, steel light bases or grounding bushings on steel conduits to the fixture ground system by a No. 4 AWG bare-stranded copper wire. Semiflush (pancake) fixtures for direct mounting in pavement may not be grounded. Connect copper wire to the fixture ground rods by exothermic weld.

3.13 WIND DIRECTION INDICATORS

Installation shall include a 25 foot black circle constructed on the ground with center at center of the base. Construct circle of an emulsified asphalt-sand mixture or of a cut-back asphalt sand mixture and not less than 5 inches in thickness. Asphalt sand mixture shall contain not less than 6 percent bitumen. Provide well graded sand with not more than 10 percent material which will pass through a No. 200 mesh sieve. Compact asphalt-sand mixture thoroughly and slope for drainage from center to outer rim from one side to the other.

3.14 ISOLATION TRANSFORMERS

Make connections of transformer primary leads to primary cables with connectors conforming to FAA AC 150/5345-26. Make connection to transformer secondary with connectors conforming to FAA AC 150/5345-26 and plug directly into a mating connector on the transformer secondary leads. During installation, keep mating surfaces of connectors covered until connected and clean when plugged together. At joint where connectors come together, and install heat shrinkable tubing with waterproof sealant at both and the heat shrink tubing.The Contractor shall provide two half-lapped layers of high voltage splicing tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.15 FIELD QUALITY CONTROL

Give the Contracting Officer 5 working days notice prior to each test. Correct deficiencies found and repeat tests. Field test reports shall be written, signed and provided as each circuit or installation is completed. Field tests shall include resistance-to-ground and resistance between conductors and continuity measurements for each circuit. For each series circuit, the input voltage and output current of the constant current regulator at each intensity setting shall be measured and the output current adjusted as required. A visual inspection of the lights operation or the markings appearance, or of the fixture or units installed shall be reported in writing.

3.15.1 Operating Test

After installation has been completed, conduct an operating test. Demonstrate equipment to operate in accordance with the requirements of this section. Conduct tests one day and one night for the Contracting Officer.

3.15.2 Electromagnetic Interference

Conduct tests for electromagnetic compatibility in accordance with MIL-STD-461 Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS. Conduct tests for vault and airfield lighting equipment as ordered by the Contracting Officer.

3.15.3 Distribution Conductors, 600-Volt Class

Test to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts providing a direct reading in resistance.

3.15.4 Counterpoise System Test and Inspection

Make a visual inspection of continuity of counterpoise system at accessible locations. Test continuity of counterpoise system to the vault grounding system in manhole closest to the vault.

3.15.5 Progress Testing for Series Airfield Lighting Circuits

Conduct a megger test on each section of circuit or progressive combinations of sections as they are installed. Check each section or progressive combination of sections with a megohmmeter providing a voltage of approximately 1000 volts for 5KV and 500 volts for 600V cables to provide a direct reading in resistance, and document results. The insulation resistance-to-ground shall not be less than 100 megohm.Locate any faults indicated by these tests and eliminate before completing with the circuit installation.

3.15.6 Electrical Acceptance Tests

Perform acceptance tests for series and multiple airfield lighting circuits only on complete lighting circuits. Subject each series and multiple lighting circuit to a high voltage insulation resistance test.

3.15.6.1 Low Voltage Continuity Tests

Test each series circuit for electrical continuity. Locate faults indicated by this test and eliminate before proceeding with the high voltage insulation resistance test.

3.15.6.2 High Voltage Insulation Resistance Test

Subject each series lighting circuit to a high voltage insulation resistance test by measurement of the insulation leakage current. Provide a suitable high voltage test instrument which has a steady, filtered direct current output voltage and limited current. High voltage tester shall include an accurate voltmeter and microammeter for reading voltage applied to the circuit and resultant insulation leakage current. Do not apply voltages in excess of test values specified below.

a. Test Procedure: Disconnect both leads from regulator output terminals and support so that air gaps of several inches exist between bare conductors and ground. Clean and dry cable sheaths, for a distance of one foot from ends of cables and exposed insulation at ends of cables. Connect ends of both conductors of the circuit together and to high-voltage terminals of test equipment, and apply test voltage specified in the following tabulation between conductors and ground for

a period of 5 minutes.

	Test Voltage, dc	
Series Lighting Circuits	First Test on New Circuits	Test on Existing Circuits
High intensity series lighting circuits (5000-volt leads, 500- and 200-watt transformers)	9000	5000
Medium intensity series lighting circuits (5000-volt leads, 30/45-watt transformers)	6000	3000
600-volt circuits	1800	600

When additions are made to existing circuits, test only new sections in accordance with "First Test on New Circuits" in table above. To ensure reliable operation, test complete circuit at reduced voltages indicated above.

b. Leakage Current: Measure and record insulation leakage current in microamperes for each circuit for each minute application of test voltage. Do not exceed the value of the insulation leakage current calculated on the basis of the following leakage current allowances for cable and connected equipment for each circuit:

(1) 3 microamperes for each 1000 feet of cable.

(2) 2 microamperes for each 200-watt and each 500-watt 5000-volt series transformer.

(3) 2 microamperes for each 30/45-watt 5000-volt series transformer.

Note: The above values include allowances for the normal number of connectors and splices.

If measured value of insulation leakage current exceeds calculated value, sectionalize the circuit and repeat specified test for each section. Locate defective components and repair or replace until repeated tests indicate an acceptable value of leakage current for the entire circuit.

3.15.6.3 Operating Test

Upon completion of tests, show by demonstration in service that circuits, control equipment, and lights covered by the contract are in good operating condition. Operate each switch in the control tower lighting panels so that each switch position is engaged at least twice. During this process, observe lights and associated equipment to determine that each switch controls properly corresponding circuit. Provide telephone or radio communication between the operator and the observers. Repeat tests from

the alternate control station, from the remote control points, and again from the local control switches on the regulators. Test each lighting circuit by operating the lamps at maximum brightness for not less than 30 minutes. Visually examine at the beginning and at the end of this test to ensure that the correct number of lights are burning at full brightness. Conduct one day and one night operating test for the Contracting Officer.

3.15.7 Constant Current Regulators

3.15.7.1 Visual Examination

Examine each constant current regulator to ensure that porcelain bushings are not cracked, no shipping damage has occurred, internal and external connections are correct, switches and relays operate freely and are not tied or blocked, fuses, if required, are correct, and oil level of oil-filled regulators is correct. Remove relay panel covers only for this examination; it is not necessary to open the main tank of oil-filled regulators. Accomplish the instructions on the plates attached to the regulators. Replace covers tightly after completing examinations and tests.

3.15.7.2 Electric Tests

Ensure that supply voltage and input tap correspond. With load disconnected, energize regulator and observe the open circuit protector to ensure that it de-energizes the regulator within 3 seconds. After testing circuits for open connections and grounds and after determining that lamps are good and in place, apply circuit load to the regulator and measure the voltage and current simultaneously on brightness taps. Voltmeter and ammeter shall have an accuracy of plus or minus one percent. Record readings and make readings during the day and night in order to obtain the average supply voltage. Output current on each brightness tap shall be within plus or minus 2 percent of the nameplate values after making necessary correction in the supply voltage. Late model regulators have automatic supply voltage correction in lieu of input taps, and output current does not change as supply voltage varies. When output current on tap 5 deviates from nameplate value by more than 2 percent, and regulator is not overloaded, check internal adjustment as described on regulator instruction plate. Since adjustment may be rather delicate, allow a deviation of up to plus or minus 5 percent on taps 1 through 4 before attempting to readjust the regulator.

-- End of Section --