GSI & Whitesell-Green

A JOINT VENTURE

P O J E C T M A N U A L

HANGAR 456 RENOVATION
Contract Number: FA3022-15-C-0001
Columbus AFB, Mississippi

SPECIFICATIONS – 65% Submittal

DATE: 18 November 2015

DESIGN TEAM

Architecture
Heffernan Holland Morgan Architecture
312 S. Alcaniz St. Pensacola, Fla. 32505

Civil Engineers
Rebol-Battle & Associates
2301 N. 9th Ave. Suite 300 Pensacola, Fla. 32503

Cathodic Protection
Maggart & Associates, Inc.
5002 North Royal Atlanta Dr. Suite D Tucker, GA 30084

Structural Engineers
Joe DeReuil Associates
301 W. Cervantes St. Pensacola, Fla. 32501

Electrical Engineers
Bagwell Engineering, Inc.
216 E. Government St. Pensacola, Fla.32502

Mechanical Engineers
Peterson Engineering Inc.
75 South F Street Pensacola, Fla. 32502

2993 Wallace Lake Road – Pace, FL 32571
Phone: 850 554-7149
Email: GSI.WhitesellGreen@gmail.com

PROJECT TABLE OF CONTENTS

-- End of Project Table of Contents --

SECTION 01 11 00

SUMMARY OF WORK
08/11

PART 1 GENERAL

1.1 DEFINITIONS

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.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

1.2.1 Project Description

The work includes the following:

General New Work: New building construction will be composed of the following; a) New 18' x 28' fire protection and storage building added to the southwest corner of the hangar; b) New 40' x 60' administrative addition added to the northwest side of the building containing reception area, offices, locker room, janitors closet and bathroom facilities; and c) New 21'-4" x 41'-4" pump house located adjacent to the northwest corner of Building 441.

Specific New Work: ADA-compliant bathrooms with solid surface countertops, solid phenolic toilet partitions and tile flooring; additions consisting of steel-framed roof on CMU bearing walls tied into the existing hangar framing; finishes matching exterior of Hangar 450 of brick veneer, metal siding, and standing seam metal roof; roof system consisting of metal decking, rigid R-30 insulation, adhesive-backed bituminous membrane, and standing seam roof panels; new 1 hour CMU/metal stud wall separating the aircraft hangar area from the new administrative addition; interior finishes in administrative area includes new carpet and tile floors, painted gypsum wallboard walls, tile wainscot in bathrooms and lockers, and 2' x 2' tegular edge lay-in acoustical ceiling system with painted gypsum board ceilings in wet areas; windows in administrative addition will be blast-rated commercial aluminum and entry doors will be aluminum storefront type; exterior doors and frames will be hollow metal frames; interior doors will be solid core wood in hollow metal frames; interior finishes in hangar area includes epoxy-painted floors and painted CMU at all exterior walls with insulated metal panels above; new vertical folding fabric door equal to Megadoor 1500 Series, 3-part fabric door; new coiling overhead doors; provide all new civil, structural, mechanical, plumbing, fire protection, and electrical components; and complete all incidental related work.

The new pump house will be constructed of load-bearing CMU walls with brick veneer (to match Hangar 456), metal bar joists with metal deck and modified bituminous membrane roofing, and painted hollow metal doors and frames.

Demolition: All existing out buildings, mechanical pads and asphalt paving on the west side of Hangar 456 will be removed and existing foundations and slabs shall be removed in their entirety; all exterior corrugated siding and interior liner panels shall be removed from the existing hangar (removal of the siding will require removal of numerous conduits, panels and piping from both the exterior and interior walls); all existing corrugated roofing, insulation, flashing, gutter, and downspouts shall be removed; two existing sliding hangar door and one coiling overhead door on the west side shall be removed; various existing exterior man doors shall be removed; existing rolling aircraft doors on the east side and steel track shall be removed; existing steel access stair and catwalk shall be removed; existing rest room shall be removed from the interior of the hangar; existing hangar floor shall be cleaned and stripped of existing finish; existing gantry beams shall be removed; and demolition items for civil, structural, mechanical, plumbing, fire protection, and electrical work.

1.2.2 Location

The work shall be located at the Columbus Air Force Base, Columbus, MS, approximately as indicated. The exact location will be shown by the Contracting Officer.

1.3 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

Drawing No. [_____]
Sheets 1 through [_____]

1.4 PROJECT ENVIRONMENTAL GOALS

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 OCCUPANCY OF PREMISES

Building(s) will not be occupied during performance of work under this Contract.

Before work is started, the Contractor shall arrange with the Contracting Officer a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

1.6 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.

1.7 ON-SITE PERMITS

1.7.1 Utility Outage Requests and Utility Connection Requests

Notify the Contracting Officer at least 48 hours prior to starting excavation work. Contractor is responsible for marking and verifying all utilities not marked.

The Contractor shall verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed. But indicated in locations to be transversed by piping, ducts, and other work to be installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

Work shall be scheduled to hold outages to a minimum.

Utility outages and connections required during the prosecution of work that affect existing systems shall be arranged for at the convenience of the Government and shall be scheduled outside the regular working hours or on weekends.

Contracting Officer may permit utility outages at his discretion.

Requests for utility outages and connections shall be made in writing to the Contracting Officer at least 7 calendar days in advance of the time required. Each request shall state the system involved, area involved, approximate duration of outage, and the nature of work involved.

1.8 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 or paved surface 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.

1.8.1 Notification Prior to Excavation

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

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 14 00

WORK RESTRICTIONS
11/11

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 State

"State" when used in reference to states of the United States.

1.2 CONTRACTOR ACCESS AND USE OF PREMISES

1.2.1 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.

1.2.1.1 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.

1.2.1.2 Identification Badges and Installation Access

Application for and use of badges will be as directed. Obtain access to the installation by participating in the Navy Commercial Access Control System (NCACS), or by obtaining passes each day from the Base Pass and Identification Office. Costs for obtaining passes through the NCACS are the responsibility of the Contractor. One-day passes, issued through the Base Pass and Identification Office, will be furnished without charge. Furnish a completed EMPLOYMENT ELIGIBILITY VERIFICATION (DHS FORM I-9) form for all personnel requesting badges. This form is available at http://www.uscis.gov/portal/site/uscis by searching or selecting Employment Verification (Form I-9). Immediately report instances of lost or stolen badges to the Contracting Officer.

a. NCACS Program: NCACS is a voluntary program in which Contractor personnel who enroll, and are approved, are subsequently granted access to the installation for a period up to one year, or the length of the contract, whichever is less, and are not required to obtain a new pass from the Base Pass and Identification Office for each visit. The Government performs background screening and credentialing. Throughout the year the Contractor employee must continue to meet background screening standards. Periodic background screenings are conducted to verify continued NCACS participation and installation access privileges. Under the NCACS program, no commercial vehicle inspection is required, other than for Random Anti-Terrorism Measures (RAM) or in the case of an elevation of Force Protection Conditions (FPCON). Information on costs and requirements to participate and enroll in

NCACS is available at http://www.rapidgate.com or by calling 1-877-727-4342. Contractors should be aware that the costs incurred to obtain NCACS credentials, or costs related to any means of access to a Navy Installation, are not reimbursable. Any time invested, or price(s) paid, for obtaining NCACS credentials will not be compensated in any way or approved as a direct cost of any contract with the Department of the Navy.

(1) Delivery companies submitting NCACS applications must only be granted access if the prime Contractor has included the company on a participant's spreadsheet provided in advance to the Contracting Officer. This form must be provided by the Government upon request.

(2) Delivery companies NOT participating in NCACS must have documentation identifying the destination location (building no., street, etc.), Project title,Contract No., Prime Contractor organization, Bill of Lading & Proof of Citizenship. Otherwise, no access will be allowed.

(3) For those companies that do not have a bill of lading or proof of citizenship the prime contractor must fill out the Short Term Visitor Request form and provide to the Contracting Officer no less than 5 workdays prior to the delivery date.

b. One-Day Passes: Participation in the NCACS is not mandatory, and if the Contractor chooses to not participate, the Contractor's personnel will have to obtain daily passes, be subject to daily mandatory vehicle inspection, and will have limited access to the installation. The Government will not be responsible for any cost or lost time associated with obtaining daily passes or added vehicle inspections incurred by non-participants in the NCACS.

1.2.1.3 Employee List

The Contractor must provide to the Contracting officer, in writing, the names of two designated representatives authorized to request personnel and vehicle passes for employees and subcontractor's employees prior to commencement of work under this contract.

1.2.1.4 Personnel Entry Approval

Failure to obtain entry approval will not affect the contract price or time of completion.

1.2.1.5 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.

1.2.2 Emergency Response Requirement

This requirement includes Contractors, Subcontractors, and any person who is employed by the Contractor.

The most appropriate protective action for certain emergencies is to take shelter. Personnel must immediately seek shelter while an assessment is made of the threat and determinations are being made regarding subsequent actions such as "all clear" or selected building evacuations. The following procedures have been put in place in the event of an emergent condition.

1. NOTIFICATION: The primary means of alerting personnel must be emergency alert signals. The alerting signal to seek shelter must be three steady tones that last for thirty seconds separated by ten seconds of silence. The notification for "all clear" must be three short tones repeated three times.

2. SHELTERING: When personnel hear the alert signal, the area of work must be secured in a manner that will leave the site in safe condition. Personnel must seek shelter in the nearest occupied building in calm and orderly manner. If possible, secure all windows and doors and shut off ventilation. If working aboard ship, proceed into the interior of the ship and wait for further directions from official personnel. If in a vehicle, park the vehicle so that it does not block the normally traveled portion of the road and proceed into the nearest occupied building.

3. EVACUATION: In the event of an evacuation, personnel must receive directions from Base Security. Contract personnel must comply with instructions given at all times.

1.2.3 Working Hours

Regular working hours shall consist of a period mutually acceptable to Contractor and Contracting Officer Monday through Friday, excluding Government holidays.

1.2.4 Work Outside Regular Hours

Work outside regular 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. Make utility cutovers after normal working hours or on Saturdays, Sundays, and Government holidays unless directed otherwise.

1.2.5 Existing Buildings

The Contractor shall be working in an existing building which is not occupied.

The Government will remove and relocate Government property in the areas of the buildings scheduled to receive work.

1.2.6 Utility Cutovers and Interruptions

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

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

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

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES
05/11

PART 1 GENERAL

1.1 SUMMARY

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.
Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

A submittal register showing items of equipment and materials for when submittals are required by the specifications is provided as "Appendix A - Submittal Register."

1.2 DEFINITIONS

1.2.1 Submittal Descriptions (SD)

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

SD-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.

Design submittals, design substantiation submittals and extensions of design submittals.

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.

1.2.2 Approving Authority

Office or designated person authorized to approve submittal.

1.2.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, except those SD-01 Pre-Construction Submittals noted above, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1 Designer of Record Approved (DA)

Designer of Record (DOR) approval is required for extensions of design, critical materials, any deviations from the solicitation, the accepted proposal, or the completed design, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings." Contractor to provide the Government with the number of copies designated hereinafter of all DOR approved submittals. The Government may review any or all Designer of Record approved submittals for conformance to the Solicitation, Accepted Proposal and the completed design. The Government will review all submittals designated as deviating from the Solicitation or Accepted Proposal, as described below. Design submittals to be in accordance with Section 01 33 16 DESIGN AFTER AWARD. Generally, design submittals should be identified as SD-05 Design Data submittals.

1.3.2 Government Approved (G)

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Government approval is required for any deviations from the Solicitation or Accepted Proposal and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.4 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.4.1 Submittals Required from the Contractor

As soon as practicable after award of contract, and before procurement of fabrication, forward to the Architect-Engineer: submittals required in the technical sections of this specification, including shop drawings, product data and samples. Forward one copy of the transmittal form for all submittals to the Resident Officer in Charge of Construction.

The Architect-Engineer for this project will review and approve for the Contracting Officer those submittals reserved for Contracting Officer approval to verify submittals comply with the contract requirements.

1.4.1.1 O&M Data

The Architect-Engineer for this project 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.

1.5 PREPARATION

1.5.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to office of approving authority. Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project. 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 .

Use the attached sample transmittal form in Appendix B ENG Form 4025-R for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor orare included in the QCS software that the Contractor is required to use for this contract. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.5.2 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.

1.5.3 Format for SD-02 Shop Drawings

Shop drawings are not to be less than 8 1/2 by 11 inches nor more than 22 by 34 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. Contractors may use their own number system. 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 PDF format.

1.5.4 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.

1.5.5 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.

1.5.6 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.

1.5.7 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.

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

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.5.9 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.

1.6 QUANTITY OF SUBMITTALS

1.6.1 Number of Copies of SD-02 Shop Drawings

Submit five copies of submittals of shop drawings requiring review and approval only by QC organization and seven copies of shop drawings requiring review and approval by Contracting Officer.

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

Submit in compliance with quantity requirements specified for shop drawings.

1.6.3 Number of Samples SD-04 Samples

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

b. Submit one sample panel 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.

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

Submit in compliance with quantity requirements specified for shop drawings.

1.6.5 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.

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

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

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

Unless otherwise specified, submit three sets of administrative submittals.

1.7 SUBMITTAL REGISTER AND DATABASE

Prepare and maintain submittal register, as the work progresses. Use electronic submittal register program furnished by the Government or any other format. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by Government; retain data which is output in columns (a), (g), (h), and (i) as approved. 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. Maintain a submittal register for the project in accordance with Section 01 45 00.10 20 QUALITY CONTROL SYSTEM (QCS).

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.

The database and submittal management program will be furnished to Contractor on a Writable Compact Disk (CD-R), for operation on Windows based personal computer.

The Designer of Record develops a complete list of submittals during design and identify required submittals in the specifications, and use the list to prepare the Submittal Register. The list may not be all inclusive and additional submittals may be required by other parts of the contract. Complete the submittal register and submit it to the Contracting Officer for approval within 30 calendar days after Notice to Proceed. The approved submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period.

Coordinate the submit dates and need dates with dates in the Contractor prepared progress schedule. Submit monthly or until all submittals have been satisfactorily completed, updates to the submittal register showing the Contractor action codes and actual dates with Government action codes. Revise the submittal register when the progress schedule is revised and submit both for approval.

1.7.1 Use of Submittal Register

Submit submittal register as an electronic database, using submittals management program furnished to Contractor. Submit 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 database 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 Action Codes

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

1.7.3.1 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"

1.7.3.2 Contractor Action Codes

NR - Not Received

AN - Approved as noted

A - Approved

RR - Disapproved, Revise, and Resubmit

1.7.4 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request. Deliver in electronic format, unless a paper copy is requested by Contracting Officer.

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.

f. For submittals requiring review by fire protection engineer, allow review period, beginning when Government receives submittal from QC organization, of 30 working days for return of submittal to the Contractor.

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

Within 15 calendar days of notice to proceed for Construction, provide, for approval by the Contracting Officer, the following schedule of submittals:

a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).

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 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 EEPZ 10-1001, 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 EEPZ 10-1001, 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 database 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.

Upon completion of review of submittals requiring Government approval, stamp and date submittals. Two copies of the submittal will be retained by the Contracting Officer and five copies of the submittal will be returned to the Contractor. If the Government performs a conformance review of other Designer of Record approved submittals, the submittals will be so identified and returned, as described above.

1.9.1 Review Notations

Contracting Officer review will be completed within seven calendar days after date of submission. 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 OR REJECTED 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/ACCEPTED 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. design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal.

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 design, dimensions, all design extensions, such as the design of adequate connections and details, etc., 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.

1.13 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained. No payment for materials incorporated in the work will be made if all required Designer of Record or required Government approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

1.14 PROGRESS SCHEDULE

1.14.1 Bar Chart

a. Submit the progress chart, for approval by the Contracting Officer, at the Preconstruction Conference in one reproducible and 4 copies.

b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.

c. Include no less than the following information on the progress chart:

(1) Break out by major headings for primary work activity.

(2) A line item break out under each major heading sufficient to track the progress of the work.

(3) A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.

(4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.

(5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.

(6) Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)

d. Update the progress schedule in one reproduction and 4 copies every 30 calendar days throughout the contract performance period.

1.15 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements is to be similar to the following:

CONTRACTOR (Firm Name)   _____ Approved _____ Approved with corrections as noted on submittal data and/or attached sheets(s)   SIGNATURE: _____ TITLE: _____ DATE: _____

For design-build construction, both the Contractor Quality Control System Manager and the Designer of Record are to stamp and sign to certify that the submittal meets contract requirements.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
Line	Activity #	Trans-mittal #	Specification Section	SD #	Submittal Description	Item Submitted	Paragraph #	Classification: GOVT or A/E Revwr	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 Revwr	Date RCD From Other Revwr	Action Code	Date Of Action	Mailed To CONTR/ Date RCD From APPR Authority	Remarks
1			03 30 53	02	Shop Drawings	Installation Drawings		G												
2			03 30 53	03	Product Data	Air-Entraining Admixture	2.2.3.1													
3			03 30 53	03	Product Data	Water-Reducing or Retarding Admixture	2.2.3.2													
4			03 30 53	03	Product Data	Curing Materials	2.2.9													
5			03 30 53	03	Product Data	Batching and Mixing Equipment														
6			03 30 53	03	Product Data	Conveying and Placing Concrete	3.2													
7			03 30 53	03	Product Data	Mix Design Data	2.3	G												
8			03 30 53	03	Product Data	Ready-Mix Concrete	2.3													
9			03 30 53	03	Product Data	Curing Compound	2.4.3													
10			03 30 53	03	Product Data	Mechanical Reinforcing Bar Connectors	2.2.5													
11			03 30 53	06	Test Reports	Aggregates	2.2.2													
12			03 30 53	06	Test Reports	Concrete Mixture Proportions	2.1.3	G												
13			03 30 53	06	Test Reports	Water	2.2.4													
14			03 30 53	07	Certificates	Cementitious Materials	2.2.1													
15			03 30 53	07	Certificates	Pozzolan														
16			03 30 53	07	Certificates	CPG for recycled materials or appropriate Waiver Form														
17			03 30 53	07	Certificates	Aggregates	2.2.2													
18			03 30 53	07	Certificates	Delivery Tickets	2.3													
19			03 30 53	08	Manufacturer's Instructions	Chemical Floor Hardener	2.4.2													
20			03 30 53	08	Manufacturer's Instructions	Curing Compound	2.4.3													
21			04 20 00	02	Shop Drawings	Detail Drawings	1.4.2	G												
22			04 20 00	03	Product Data	Cement		G												
23			04 20 00	03	Product Data	Cold Weather Installation	1.6.2	G												
24			04 20 00	03	Product Data	Water-Repellant Admixture	2.4	G												
25			04 20 00	04	Samples	Concrete Masonry Units (CMU)	2.2	G												
26			04 20 00	04	Samples	Anchors, Ties, and Bar Positioners	2.6	G												
27			04 20 00	04	Samples	Expansion-Joint Materials	2.10	G												
28			04 20 00	04	Samples	Joint Reinforcement	2.7	G												
29			04 20 00	05	Design Data	Pre-mixed Mortar		G												
30			04 20 00	05	Design Data	Unit Strength Method	1.2.1.1	G												
31			04 20 00	06	Test Reports	Field Testing of Mortar	3.16.1	G												
32			04 20 00	06	Test Reports	Field Testing of Grout	3.16.2	G												
33			04 20 00	06	Test Reports	Masonry Cement		G												
34			04 20 00	06	Test Reports	Masonry Inspector Qualifications	1.4.1	G												

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
35			04 20 00	06	Test Reports	Single-Wythe Masonry Wall Water Penetration Test														
36			04 20 00	07	Certificates	Concrete Masonry Units (CMU)	2.2													
37			04 20 00	07	Certificates	Anchors, Ties, and Bar Positioners	2.6													
38			04 20 00	07	Certificates	Expansion-Joint Materials	2.10													
39			04 20 00	07	Certificates	Joint Reinforcement	2.7													
40			04 20 00	07	Certificates	Masonry Cement														
41			04 20 00	07	Certificates	Admixtures for Masonry Mortar														
42			04 20 00	07	Certificates	Admixtures for Grout	2.5.1													
43			04 20 00	07	Certificates	Contamination														
44			04 20 00	08	Manufacturer's Instructions	Masonry Cement														
45			05 12 00	01	Preconstruction Submittals	Erection Drawings	1.3.1.1	G												
46			05 12 00	02	Shop Drawings	Fabrication drawings	1.3.2	G												
47			05 12 00	03	Product Data	Shop primer	2.5.2	G												
48			05 12 00	03	Product Data	Welding electrodes and rods	2.4.1	G												
49			05 12 00	03	Product Data	Non-Shrink Grout	2.4.2	G												
50			05 12 00	03	Product Data	Tension control bolts	2.3.3	G												
51			05 12 00	06	Test Reports	Bolts, nuts, and washers	2.3													
52			05 12 00	06	Test Reports	Weld Inspection Reports	3.7.1.2													
53			05 12 00	06	Test Reports	Bolt Testing Reports	3.7.2.1													
54			05 12 00	07	Certificates	Steel	2.2													
55			05 12 00	07	Certificates	Bolts, nuts, and washers	2.3													
56			05 12 00	07	Certificates	AISC Fabrication Plant Quality Certification		G												
57			05 12 00	07	Certificates	Welding procedures and qualifications	1.3.3.1	G												
58			05 12 00	07	Certificates	Welding electrodes and rods	2.4.1	G												
59			05 21 19	01	Preconstruction Submittals	Welder qualification	1.5.2													
60			05 21 19	01	Preconstruction Submittals	Material Safety Data Sheet	1.5.2													
61			05 21 19	02	Shop Drawings	Steel joist framing	1.5.1	G												
62			05 21 19	06	Test Reports	Erection inspection	3.4.1													
63			05 21 19	06	Test Reports	Welding inspections	3.4.1													
64			05 21 19	07	Certificates	Accessories	2.1													
65			05 21 19	07	Certificates	Certification of Compliance	1.5.2													
66			05 30 00	02	Shop Drawings	Fabrication Drawings	1.3.5													
67			05 30 00	02	Shop Drawings	Cant Strips														
68			05 30 00	02	Shop Drawings	Ridge and Valley Plates	2.3.2.1													
69			05 30 00	02	Shop Drawings	Metal Closure Strips	2.3.2.2													
70			05 30 00	03	Product Data	Accessories	2.2													
71			05 30 00	03	Product Data	Deck Units	2.3.1													
72			05 30 00	03	Product Data	Galvanizing Repair Paint	2.1.3.1													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
73			05 30 00	03	Product Data	Galvanizing Repair Paint	2.1.6													
74			05 30 00	03	Product Data	Joint Sealant Material	2.1.5													
75			05 30 00	03	Product Data	Mechanical Fasteners	2.2.8													
76			05 30 00	03	Product Data	Powder-Actuated Tool Operator	1.3.2													
77			05 30 00	03	Product Data	Repair Paint	2.3.3													
78			05 30 00	03	Product Data	Welder Qualifications	1.3.3													
79			05 30 00	03	Product Data	Welding Equipment	1.3.3													
80			05 30 00	03	Product Data	Welding Rods and Accessories	1.3.3													
81			05 30 00	04	Samples	Metal Roof Deck Units														
82			05 30 00	04	Samples	Flexible Closure Strips	2.1.7													
83			05 30 00	04	Samples	Accessories	2.2													
84			05 30 00	05	Design Data	Deck Units	2.3.1													
85			05 30 00	07	Certificates	Welding Procedures	1.3.3													
86			05 30 00	07	Certificates	Fire Safety	1.3.4.1													
87			05 30 00	07	Certificates	Wind Storm Resistance	1.3.4.2													
88			05 40 00	02	Shop Drawings	Framing Components	1.6.1	G												
89			05 40 00	03	Product Data	studs,joists	2.1													
90			05 40 00	07	Certificates	Load-bearing cold-formed metal framing	1.4													
91			05 40 00	07	Certificates	Welds	3.1.1													
92			06 41 16.00 10	02	Shop Drawings	Shop Drawings	2.9													
93			06 41 16.00 10	02	Shop Drawings	Installation	3.1													
94			06 41 16.00 10	03	Product Data	Wood Materials	2.1													
95			06 41 16.00 10	03	Product Data	Wood Finishes	2.8													
96			06 41 16.00 10	04	Samples	Plastic Laminates	2.3													
97			06 41 16.00 10	04	Samples	Cabinet Hardware	2.5													
98			06 41 16.00 10	07	Certificates	Quality Assurance	1.4													
99			06 61 16	02	Shop Drawings	Detail Drawings		G												
100			06 61 16	02	Shop Drawings	Installation	3.1	G												
101			06 61 16	03	Product Data	Solid polymer material	2.1													
102			06 61 16	03	Product Data	Qualifications	1.4.1													
103			06 61 16	03	Product Data	Fabrications	2.3													
104			06 61 16	03	Product Data	Certification														
105			06 61 16	03	Product Data	VOC Content														
106			06 61 16	04	Samples	Material	2.1	G												
107			06 61 16	06	Test Reports	Solid polymer material	2.1													
108			06 61 16	07	Certificates	Fabrications	2.3													
109			06 61 16	07	Certificates	Qualifications	1.4.1													
110			06 61 16	10	Operation and Maintenance Data	Clean-up	3.2													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
111			07 11 13	07	Certificates	Materials	1.3													
112			07 21 16	03	Product Data	Blanket insulation	2.1													
113			07 21 16	03	Product Data	Accessories	2.5													
114			07 21 16	08	Manufacturer's Instructions	Insulation	3.2.1													
115			07 22 00	03	Product Data	Fasteners	2.2	G												
116			07 22 00	03	Product Data	Insulation	2.1	G												
117			07 22 00	03	Product Data	Certification														
118			07 22 00	06	Test Reports	Flame spread and smoke developed ratings	1.4.1													
119			07 22 00	07	Certificates	qualifications	1.3													
120			07 22 00	08	Manufacturer's Instructions	Fasteners	2.2													
121			07 22 00	08	Manufacturer's Instructions	insulation	2.1													
122			07 42 13	01	Preconstruction Submittals	Qualification of Manufacturer	1.5.2	G												
123			07 42 13	01	Preconstruction Submittals	Qualification of Installation Contractor	1.5.3	G												
124			07 42 13	01	Preconstruction Submittals	Warranty	1.8	G												
125			07 42 13	02	Shop Drawings	Installation Drawings		G												
126			07 42 13	03	Product Data	Insulated Wall Panels		G												
127			07 42 13	03	Product Data	Factory Color Finish	2.2.2													
128			07 42 13	03	Product Data	Closure Materials	1.5.4													
129			07 42 13	03	Product Data	Sealants and Caulking	2.5.3.1													
130			07 42 13	03	Product Data	Enamel Repair Paint														
131			07 42 13	03	Product Data	Accessories	1.5.4													
132			07 42 13	03	Product Data	Accessories	2.5													
133			07 42 13	04	Samples	Wall Panels	2.2.1	G												
134			07 42 13	04	Samples	Fasteners		G												
135			07 42 13	04	Samples	Metal Closure Strips		G												
136			07 42 13	04	Samples	Color chart		G												
137			07 42 13	05	Design Data	Wind load design analysis		G												
138			07 42 13	06	Test Reports	Leakage Tests	3.7.2	G												
139			07 42 13	06	Test Reports	Wind Load Tests		G												
140			07 42 13	06	Test Reports	Coating	2.2.2.6	G												
141			07 42 13	07	Certificates	Coil Stock		G												
142			07 42 13	07	Certificates	Fasteners		G												
143			07 42 13	08	Manufacturer's Instructions	Installation	3.3	G												
144			07 42 13	11	Closeout Submittals	Warranty	1.8	G												
145			07 42 13	11	Closeout Submittals	Maintenance Instructions	1.5.5	G												
146			07 61 14.00 20	02	Shop Drawings	Roofing	1.2.4	G												
147			07 61 14.00 20	03	Product Data	Roofing panels	2.1	G												
148			07 61 14.00 20	03	Product Data	Attachment clips	2.3													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
149			07 61 14.00 20	03	Product Data	Closures	2.4.1													
150			07 61 14.00 20	03	Product Data	Accessories	2.4													
151			07 61 14.00 20	03	Product Data	Fasteners	2.4.2													
152			07 61 14.00 20	03	Product Data	Sealants	2.4.3													
153			07 61 14.00 20	03	Product Data	warranty	1.7	G												
154			07 61 14.00 20	04	Samples	panel	2.1													
155			07 61 14.00 20	04	Samples	Accessories	2.4													
156			07 61 14.00 20	05	Design Data	Design calculations	1.5													
157			07 61 14.00 20	07	Certificates	Manufacturer's Technical Representative	1.6.3													
158			07 61 14.00 20	07	Certificates	Installer's Qualifications	1.6.4													
159			07 61 14.00 20	08	Manufacturer's Instructions	Installation	3.3	G												
160			07 61 14.00 20	11	Closeout Submittals	Information card	3.8													
161			07 92 00	03	Product Data	Sealants	2.1													
162			07 92 00	03	Product Data	Primers	2.2													
163			07 92 00	03	Product Data	Bond breakers	2.3													
164			07 92 00	03	Product Data	Backstops	2.4													
165			07 92 00	07	Certificates	Sealant	3.3.6													
166			08 11 13	02	Shop Drawings	Doors	2.1	G												
167			08 11 13	02	Shop Drawings	Doors	2.1	G												
168			08 11 13	02	Shop Drawings	Frames	2.5	G												
169			08 11 13	02	Shop Drawings	Frames	2.5	G												
170			08 11 13	02	Shop Drawings	Accessories	2.3													
171			08 11 13	02	Shop Drawings	Weatherstripping	2.7													
172			08 11 13	03	Product Data	Doors	2.1	G												
173			08 11 13	03	Product Data	Frames	2.5	G												
174			08 11 13	03	Product Data	Accessories	2.3													
175			08 11 13	03	Product Data	Weatherstripping	2.7													
176			08 14 00	02	Shop Drawings	Doors	2.1	G												
177			08 14 00	03	Product Data	Doors	2.1	G												
178			08 14 00	06	Test Reports	Cycle-slam														
179			08 14 00	06	Test Reports	Hinge loading resistance														
180			08 33 23	02	Shop Drawings	Overhead Coiling Doors	2.3	G												
181			08 33 23	02	Shop Drawings	Counterbalancing Mechanism	1.4	G												
182			08 33 23	02	Shop Drawings	Counterbalancing Mechanism	2.5	G												
183			08 33 23	02	Shop Drawings	Manual Door Operators	1.4	G												
184			08 33 23	02	Shop Drawings	Manual Door Operators	2.6	G												
185			08 33 23	02	Shop Drawings	Bottom Bars	2.3.4	G												
186			08 33 23	02	Shop Drawings	Guides	1.3	G												

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
187			08 33 23	02	Shop Drawings	Mounting Brackets	2.5.1	G												
188			08 33 23	02	Shop Drawings	Overhead Drum	2.3.8	G												
189			08 33 23	02	Shop Drawings	Hood		G												
190			08 33 23	02	Shop Drawings	Installation Drawings	1.3	G												
191			08 33 23	03	Product Data	Overhead Coiling Doors	2.3	G												
192			08 33 23	03	Product Data	Hardware	2.4	G												
193			08 33 23	03	Product Data	Counterbalancing Mechanism	1.4	G												
194			08 33 23	03	Product Data	Counterbalancing Mechanism	2.5	G												
195			08 33 23	03	Product Data	Manual Door Operators	1.4	G												
196			08 33 23	03	Product Data	Manual Door Operators	2.6	G												
197			08 33 23	05	Design Data	Overhead Coiling Doors	2.3	G												
198			08 33 23	05	Design Data	Hardware	2.4	G												
199			08 33 23	05	Design Data	Counterbalancing Mechanism	1.4	G												
200			08 33 23	05	Design Data	Counterbalancing Mechanism	2.5	G												
201			08 33 23	05	Design Data	Manual Door Operators	1.4	G												
202			08 33 23	05	Design Data	Manual Door Operators	2.6	G												
203			08 33 23	10	Operation and Maintenance Data	Operation and Maintenance Manuals	3.4	G												
204			08 33 23	10	Operation and Maintenance Data	Materials	1.4	G												
205			08 33 23	10	Operation and Maintenance Data	Devices	1.4	G												
206			08 33 23	10	Operation and Maintenance Data	Procedures	1.4	G												
207			08 33 23	10	Operation and Maintenance Data	Manufacture's Brochures	1.4	G												
208			08 33 23	10	Operation and Maintenance Data	Parts Lists	1.4	G												
209			08 33 23	10	Operation and Maintenance Data	Cleaning	3.3.2	G												
210			08 34 16.20	01	Preconstruction Submittals	Manufacturer's Qualifications	1.4.1	G												
211			08 34 16.20	01	Preconstruction Submittals	Installer's Qualifications	1.4.2	G												
212			08 34 16.20	02	Shop Drawings	Door Design	1.3.1	G												
213			08 34 16.20	03	Product Data	Electric Operator	2.3	G												
214			08 34 16.20	03	Product Data	Motors	2.3.5	G												
215			08 34 16.20	03	Product Data	Doors	2.2	G												
216			08 34 16.20	03	Product Data	Controls	2.3.6	G												
217			08 34 16.20	03	Product Data	Door Fabric	2.1.7	G												
218			08 34 16.20	03	Product Data	Surge Protection Device (SPD)	2.3.6.1	G												
219			08 34 16.20	05	Design Data	Calculations	1.3.2.1	G												
220			08 34 16.20	05	Design Data	Load Diagrams	1.3.4	G												
221			08 34 16.20	06	Test Reports	Safety Arrester Operation Test	2.3.3	G												
222			08 34 16.20	06	Test Reports	Door Fabric	2.1.7	G												
223			08 34 16.20	06	Test Reports	Door Fabric	2.1.7	G												

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
224			08 34 16.20	07	Certificates	Manufacturer's Qualifications	1.4.1	G												
225			08 34 16.20	07	Certificates	Installers Qualifications	1.4.2	G												
226			08 34 16.20	07	Certificates	Welding Procedures and Qualifications	1.5	G												
227			08 34 16.20	09	Manufacturer's Field Reports	Acceptance Testing Procedure	3.3	G												
228			08 34 16.20	10	Operation and Maintenance Data	Door Operation	2.9.1	G												
229			08 34 16.20	10	Operation and Maintenance Data	Emergency and Routine Preventative Maintenance Plan	1.4.3.1	G												
230			08 34 16.20	11	Closeout Submittals	Acceptance Testing Procedure	3.3	G												
231			08 34 16.20	11	Closeout Submittals	Warranty	1.4.3	G												
232			08 41 13	01	Preconstruction Submittals	Sample Warranty	1.2.1	G												
233			08 41 13	01	Preconstruction Submittals	Listing of Product Installations	1.2.1	G												
234			08 41 13	02	Shop Drawings	Installation Drawings	1.2.1	G												
235			08 41 13	02	Shop Drawings	Fabrication Drawings	1.2.1	G												
236			08 41 13	03	Product Data	Manufacturer's Catalog Data	1.2.1	G												
237			08 41 13	04	Samples	Finish and Color Samples	1.2.1	G												
238			08 41 13	06	Test Reports	Certified Test Reports	1.2.1	G												
239			08 41 13	07	Certificates	Manufacturer's Product Warranty	3.4	G												
240			08 71 00	02	Shop Drawings	Hardware schedule	1.3	G												
241			08 71 00	02	Shop Drawings	Keying system	2.3.8													
242			08 71 00	03	Product Data	Hardware items	2.3	G												
243			08 71 00	08	Manufacturer's Instructions	Installation	3.1													
244			08 71 00	10	Operation and Maintenance Data	Hardware Schedule	1.3	G												
245			08 71 00	11	Closeout Submittals	Key Bitting	1.4													
246			08 81 00	02	Shop Drawings	Installation	3.3.1													
247			08 81 00	02	Shop Drawings	Control Tower Insulating Glass	2.2.2.1													
248			08 81 00	02	Shop Drawings	Control Tower Laminated Glass	2.2.2.4													
249			08 81 00	03	Product Data	Insulating Glass	1.7.1													
250			08 81 00	03	Product Data	Plastic Glazing	2.3													
251			08 81 00	03	Product Data	Glazing Accessories	1.3													
252			08 81 00	03	Product Data	Local/Regional Materials	1.6.1													
253			08 81 00	03	Product Data	Environmental Data	1.6.2													
254			08 81 00	04	Samples	Insulating Glass	1.7.1													
255			08 81 00	04	Samples	Plastic Sheet	3.2.7													
256			08 81 00	04	Samples	Glazing Compound	2.4.2													
257			08 81 00	04	Samples	Tape	2.4.6													
258			08 81 00	04	Samples	Sealant	2.4.3.1													
259			08 81 00	07	Certificates	Insulating Glass	1.7.1													
260			08 81 00	07	Certificates	Plastic Glazing	2.3													
261			08 81 00	07	Certificates	Control Tower Insulating Glass	2.2.2.1													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
262			08 81 00	07	Certificates	Control Tower Laminated Glass	2.2.2.4													
263			08 81 00	07	Certificates	Glazing Accessories	1.3													
264			08 81 00	08	Manufacturer's Instructions	Setting and sealing materials	2.4													
265			08 81 00	08	Manufacturer's Instructions	Glass setting	3.2													
266			08 81 00	11	Closeout Submittals	Local/Regional Materials	1.6.1													
267			08 91 00	02	Shop Drawings	Wall louvers	1.4													
268			08 91 00	02	Shop Drawings	Wall louvers	1.5													
269			08 91 00	03	Product Data	Metal Wall Louvers	2.2													
270			08 91 00	04	Samples	Wall louvers	1.4	G												
271			08 91 00	04	Samples	Wall louvers	1.5	G												
272			08 91 00	04	Samples	Door louvers	1.5	G												
273			08 91 00	04	Samples	Door louvers	2.3	G												
274			09 29 00	03	Product Data	Cementitious backer units	2.1.8													
275			09 29 00	03	Product Data	Glass Mat Water-Resistant Gypsum Tile Backing Board	2.1.4													
276			09 29 00	03	Product Data	Water-Resistant Gypsum Backing Board	2.1.3													
277			09 29 00	03	Product Data	Glass Mat Covered or Reinforced Gypsum Sheathing	2.1.5													
278			09 29 00	03	Product Data	Glass Mat Covered or Reinforced Gypsum Sheathing Sealant	2.1.5.1													
279			09 29 00	03	Product Data	Impact Resistant Gypsum Board	2.1.6													
280			09 29 00	03	Product Data	Accessories	2.1.14													
281			09 29 00	03	Product Data	Certification	1.3													
282			09 29 00	03	Product Data	Gypsum Board	2.1.1													
283			09 29 00	03	Product Data	Adhesives	2.1.11													
284			09 29 00	03	Product Data	Joint Treatment Materials	2.1.9													
285			09 29 00	03	Product Data	Local/Regional Materials	1.6.1													
286			09 29 00	03	Product Data	Environmental Data	1.6.2													
287			09 29 00	04	Samples	Predecorated gypsum board	2.1.7	G												
288			09 29 00	07	Certificates	Asbestos Free Materials	2.1	G												
289			09 29 00	08	Manufacturer's Instructions	Material Safety Data Sheets	2.1													
290			09 29 00	10	Operation and Maintenance Data	Manufacturer maintenance instructions	2.1													
291			09 29 00	10	Operation and Maintenance Data	Waste Management	3.9													
292			09 29 00	11	Closeout Submittals	Local/Regional Materials	1.6.1													
293			09 29 00	11	Closeout Submittals	Gypsum Board	2.1.1													
294			09 29 00	11	Closeout Submittals	Adhesives	2.1.11													
295			09 30 13	02	Shop Drawings	Detail Drawings	3.2	G												
296			09 30 13	03	Product Data	Local/Regional Materials	1.4.1													
297			09 30 13	03	Product Data	Environmental Data	1.4.2													
298			09 30 13	03	Product Data	Tile	2.1	G												

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
299			09 30 13	03	Product Data	Tile	2.1	G												
300			09 30 13	03	Product Data	Setting-Bed	2.2	G												
301			09 30 13	03	Product Data	Mortar, Grout, and Adhesive	2.4	G												
302			09 30 13	03	Product Data	Reinforcing Wire Fabric	2.2.6													
303			09 30 13	04	Samples	Tile	2.1	G												
304			09 30 13	04	Samples	Accessories	2.1	G												
305			09 30 13	04	Samples	Accessories	2.1.6	G												
306			09 30 13	04	Samples	Transition Strips	2.1	G												
307			09 30 13	04	Samples	Transition Strips	2.5	G												
308			09 30 13	04	Samples	Grout	2.4	G												
309			09 30 13	07	Certificates	Tile	2.1													
310			09 30 13	07	Certificates	Mortar, Grout, and Adhesive	2.4													
311			09 30 13	08	Manufacturer's Instructions	Maintenance Instructions	3.7													
312			09 30 13	10	Operation and Maintenance Data	Installation	3.2	G												
313			09 30 13	11	Closeout Submittals	Local/Regional Materials	1.4.1													
314			09 30 13	11	Closeout Submittals	LEED Documentation	1.2													
315			09 30 13	11	Closeout Submittals	Tile	2.1													
316			09 30 13	11	Closeout Submittals	Adhesives	2.4													
317			09 51 00	02	Shop Drawings	Approved Detail Drawings	1.2													
318			09 51 00	03	Product Data	Acoustical Ceiling Systems	1.2.1													
319			09 51 00	03	Product Data	Certification	1.4													
320			09 51 00	04	Samples	Acoustical Units	2.1													
321			09 51 00	04	Samples	Acoustic Ceiling Tiles	2.1.1													
322			09 51 00	06	Test Reports	Fire Resistive Ceilings	1.2.1													
323			09 51 00	06	Test Reports	Ceiling Attenuation Class and Test	1.2.2													
324			09 51 00	07	Certificates	Acoustical Units	2.1													
325			09 51 00	07	Certificates	Acoustic Ceiling Tiles	2.1.1													
326			09 65 00	02	Shop Drawings	Resilient Flooring and Accessories	2.17	G												
327			09 65 00	03	Product Data	Resilient Flooring and Accessories	2.17	G												
328			09 65 00	03	Product Data	Adhesives	2.13													
329			09 65 00	03	Product Data	Vinyl Composition Tile	2.1													
330			09 65 00	03	Product Data	Sheet Vinyl Flooring	2.2													
331			09 65 00	03	Product Data	Rubber Tile	2.3													
332			09 65 00	03	Product Data	Rubber Sheet Flooring	2.4													
333			09 65 00	03	Product Data	Solid Vinyl Tile	2.5													
334			09 65 00	03	Product Data	Cement-Fiber Board	2.14													
335			09 65 00	03	Product Data	Wall Base	2.9													
336			09 65 00	03	Product Data	Stair Treads, Risers and Stringers	2.11													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
337			09 65 00	03	Product Data	Local/Regional Materials	1.2.3													
338			09 65 00	03	Product Data	Environmental Data	1.2.1													
339			09 65 00	03	Product Data	Sheet Linoleum	2.6													
340			09 65 00	03	Product Data	Linoleum Tile	2.7													
341			09 65 00	03	Product Data	Cork	2.8													
342			09 65 00	04	Samples	Resilient Flooring and Accessories	2.17	G												
343			09 65 00	06	Test Reports	Moisture, Alkalinity and Bond Tests	3.3	G												
344			09 65 00	08	Manufacturer's Instructions	Surface Preparation	3.2	G												
345			09 65 00	08	Manufacturer's Instructions	Installation	3.1	G												
346			09 65 00	10	Operation and Maintenance Data	Resilient Flooring and Accessories	2.17	G												
347			09 65 00	11	Closeout Submittals	LEED Documentation	1.3.1													
348			09 68 00	02	Shop Drawings	Installation Drawings	3.4	G												
349			09 68 00	02	Shop Drawings	Moldings	2.5	G												
350			09 68 00	03	Product Data	Carpet	2.1	G												
351			09 68 00	03	Product Data	Carpet Cushion	2.3	G												
352			09 68 00	03	Product Data	Moldings	2.5	G												
353			09 68 00	03	Product Data	Physical Characteristics	2.1.1													
354			09 68 00	03	Product Data	Local/Regional Materials	1.2.1													
355			09 68 00	03	Product Data	Environmental Data	1.2.2													
356			09 68 00	04	Samples	Carpet	2.1	G												
357			09 68 00	04	Samples	Moldings	2.5	G												
358			09 68 00	04	Samples	Carpet Cushion	2.3	G												
359			09 68 00	06	Test Reports	Moisture and Alkalinity Tests	3.2	G												
360			09 68 00	07	Certificates	Carpet	2.1													
361			09 68 00	07	Certificates	Regulatory Requirements	1.5													
362			09 68 00	08	Manufacturer's Instructions	Surface Preparation	3.1													
363			09 68 00	08	Manufacturer's Instructions	Installation	3.4													
364			09 68 00	10	Operation and Maintenance Data	Carpet	2.1	G												
365			09 68 00	10	Operation and Maintenance Data	Cleaning and Protection	3.5	G												
366			09 68 00	10	Operation and Maintenance Data	Maintenance Service	3.7.2													
367			09 68 00	11	Closeout Submittals	LEED Documentation	1.3.1													
368			09 68 00	11	Closeout Submittals	Local/Regional Materials	1.2.1													
369			09 90 00	02	Shop Drawings	Piping identification	3.12													
370			09 90 00	02	Shop Drawings	stencil	3.12													
371			09 90 00	03	Product Data	Certification	1.4.4													
372			09 90 00	03	Product Data	Local/Regional Materials	1.9.1													
373			09 90 00	03	Product Data	Environmental Data	1.9.2													
374			09 90 00	03	Product Data	Materials	2.1													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
375			09 90 00	03	Product Data	Coating	2.1	G												
376			09 90 00	03	Product Data	Manufacturer's Technical Data Sheets	2.1													
377			09 90 00	03	Product Data	[Sealant]	3.3.5													
378			09 90 00	04	Samples	Color	1.11	G												
379			09 90 00	04	Samples	Textured Wall Coating System	1.4.2	G												
380			09 90 00	04	Samples	Sample Textured Wall Coating System Mock-Up	1.4.3	G												
381			09 90 00	07	Certificates	Applicator's qualifications	1.3													
382			09 90 00	07	Certificates	Qualification Testing	1.4.1.2	G												
383			09 90 00	08	Manufacturer's Instructions	Application instructions	3.4.1													
384			09 90 00	08	Manufacturer's Instructions	Mixing	3.8.2													
385			09 90 00	08	Manufacturer's Instructions	Manufacturer's Material Safety Data Sheets	1.7.2													
386			09 90 00	10	Operation and Maintenance Data	Coatings:	2.1	G												
387			10 21 13	02	Shop Drawings	Fabrication Drawings	1.2													
388			10 21 13	02	Shop Drawings	Installation Drawings	3.3	G												
389			10 21 13	03	Product Data	Cleaning and Maintenance Instructions	1.2													
390			10 21 13	03	Product Data	Colors And Finishes	2.8													
391			10 21 13	03	Product Data	Galvanized Steel Sheet	2.1.1													
392			10 21 13	03	Product Data	Sound-Deadening Cores	2.1.2													
393			10 21 13	03	Product Data	Anchoring Devices and Fasteners	2.1.3													
394			10 21 13	03	Product Data	Hardware and Fittings	2.1.5													
395			10 21 13	03	Product Data	Brackets	2.1.4													
396			10 21 13	03	Product Data	Door Hardware	2.1.6													
397			10 21 13	03	Product Data	Local/Regional Materials Documentation	1.2.1.1													
398			10 21 13	03	Product Data	Environmental Data	1.2.1.2													
399			10 21 13	03	Product Data	Toilet Enclosures	2.2.1													
400			10 21 13	03	Product Data	Room Entrance Screens	2.2.2													
401			10 21 13	03	Product Data	Urinal Screens	2.2.3													
402			10 21 13	03	Product Data	Pilaster Shoes	2.6													
403			10 21 13	04	Samples	Colors and Finishes	2.8	G												
404			10 21 13	04	Samples	Hardware and Fittings	2.1.5													
405			10 21 13	04	Samples	Anchoring Devices and Fasteners	2.1.3													
406			10 21 13	07	Certificates	Warranty	1.7													
407			10 21 13	10	Operation and Maintenance Data	Plastic Identification	1.2.2													
408			10 21 13	11	Closeout Submittals	LEED Documentation	1.3.1													
409			10 21 13	11	Closeout Submittals	Local/Regional Materials Documentation	1.2.1.1													
410			10 21 13	11	Closeout Submittals	Toilet Enclosures	2.2.1													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
411			10 21 13	11	Closeout Submittals	Room Entrance Screens	2.2.2													
412			10 21 13	11	Closeout Submittals	Urinal Screens	2.2.3													
413			10 21 13	11	Closeout Submittals	Pilaster Shoes	2.6													
414			10 44 16	01	Preconstruction Submittals	Manufacturer's Data	2.1													
415			10 44 16	02	Shop Drawings	Fire Extinguishers	2.1													
416			10 44 16	02	Shop Drawings	Accessories	1.3.1													
417			10 44 16	02	Shop Drawings	Cabinets	Part 2													
418			10 44 16	02	Shop Drawings	Wall Brackets	1.3.1													
419			10 44 16	03	Product Data	Fire Extinguishers	2.1													
420			10 44 16	03	Product Data	Accessories	1.3.1													
421			10 44 16	03	Product Data	Cabinets	Part 2													
422			10 44 16	03	Product Data	Wall Brackets	1.3.1													
423			10 44 16	03	Product Data	Replacement Parts	3.2.1													
424			10 44 16	04	Samples	Fire Extinguisher	1.3.1													
425			10 44 16	04	Samples	Cabinet	1.3.1													
426			10 44 16	04	Samples	Wall Brackets	1.3.1													
427			10 44 16	04	Samples	Accessories	1.3.1													
428			10 44 16	07	Certificates	Fire Extinguishers	2.1													
429			10 44 16	07	Certificates	Manufacturer's Warranty with Inspection Tag	2.1													
430			10 51 13	02	Shop Drawings	Types	2.1	G												
431			10 51 13	02	Shop Drawings	Location	1.4	G												
432			10 51 13	02	Shop Drawings	Installation	3.1													
433			10 51 13	02	Shop Drawings	Numbering system	3.2													
434			10 51 13	03	Product Data	Material	2.2													
435			10 51 13	03	Product Data	Locking Devices	2.3.1													
436			10 51 13	03	Product Data	Lock Control Chart	2.3.1													
437			10 51 13	03	Product Data	Handles	2.3.4													
438			10 51 13	03	Product Data	Finish	2.2.3													
439			10 51 13	03	Product Data	components	2.3													
440			10 51 13	03	Product Data	Assembly	3.1													
441			10 51 13	04	Samples	Color chips	1.5.1	G												
442			22 00 00	02	Shop Drawings	Plumbing System	3.9.1	G												
443			22 00 00	03	Product Data	Fixtures	2.4													
444			22 00 00	03	Product Data	Flush valve water closets	2.4.1													
445			22 00 00	03	Product Data	Flush valve urinals	2.4.2													
446			22 00 00	03	Product Data	Countertop lavatories	2.4.3													
447			22 00 00	03	Product Data	Mop sinks	2.4.5													
448			22 00 00	03	Product Data	Drinking-water coolers	2.4.4	G												

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
449			22 00 00	03	Product Data	Water heaters	2.8	G												
450			22 00 00	03	Product Data	Pumps	2.9	G												
451			22 00 00	03	Product Data	Backflow prevention assemblies	3.9.1.1	G												
452			22 00 00	03	Product Data	Welding	1.5.1													
453			22 00 00	03	Product Data	Vibration-Absorbing Features	3.4	G												
454			22 00 00	03	Product Data	Plumbing System	3.9.1													
455			22 00 00	06	Test Reports	Tests, Flushing and Disinfection	3.9													
456			22 00 00	06	Test Reports	Test of Backflow Prevention Assemblies	3.9.1.1	G												
457			22 00 00	07	Certificates	Materials and Equipment	1.3													
458			22 00 00	07	Certificates	Bolts	2.1.1													
459			22 00 00	10	Operation and Maintenance Data	Plumbing System	3.9.1	G												
460			23 00 00	03	Product Data	Metallic Flexible Duct	2.8.1.1													
461			23 00 00	03	Product Data	Insulated Nonmetallic Flexible Duct Runouts	2.8.1.2													
462			23 00 00	03	Product Data	Duct Connectors	2.8.1.2													
463			23 00 00	03	Product Data	Duct Access Doors	2.8.2													
464			23 00 00	03	Product Data	Manual Balancing Dampers	2.8.3													
465			23 00 00	03	Product Data	Manual Balancing Dampers	2.8.4													
466			23 00 00	03	Product Data	Diffusers	2.8.7.1													
467			23 00 00	03	Product Data	Registers and Grilles	2.8.7.2													
468			23 00 00	03	Product Data	Centrifugal Fans														
469			23 00 00	03	Product Data	In-Line Centrifugal Fans	2.9.1.1													
470			23 00 00	03	Product Data	Propeller Type Power Wall Ventilators	2.9.1.2													
471			23 00 00	03	Product Data	Ceiling Exhaust Fans	2.9.1.3													
472			23 00 00	03	Product Data	Air Handling Units		G												
473			23 00 00	08	Manufacturer's Instructions	Manufacturer's Installation Instructions	3.2													
474			23 00 00	08	Manufacturer's Instructions	Operation and Maintenance Training	3.12.2													
475			23 00 00	10	Operation and Maintenance Data	Operation and Maintenance Manuals	3.12.1													
476			23 00 00	10	Operation and Maintenance Data	In-Line Centrifugal Fans	2.9.1.1	G												
477			23 00 00	10	Operation and Maintenance Data	Propeller Type Power Wall Ventilators	2.9.1.2	G												
478			23 00 00	10	Operation and Maintenance Data	Ceiling Exhaust Fans	2.9.1.3	G												
479			23 00 00	10	Operation and Maintenance Data	Air Handling Units		G												
480			23 03 00.00 20	03	Product Data	Certification														
481			23 05 93	01	Preconstruction Submittals	TAB Firm	1.5.4.1	G												
482			23 05 93	01	Preconstruction Submittals	TAB team assistants	1.2	G												
483			23 05 93	01	Preconstruction Submittals	TAB team engineer	1.2	G												
484			23 05 93	03	Product Data	Equipment and Performance Data		G												

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
485			23 05 93	03	Product Data	Calibration	1.5.2	G												
486			23 05 93	06	Test Reports	DALT and TAB Work Execution Schedule		G												
487			23 05 93	06	Test Reports	DALT and TAB Procedures Summary		G												
488			23 05 93	06	Test Reports	Pre-Final DALT report	3.3.5	G												
489			23 05 93	06	Test Reports	Final DALT report		G												
490			23 05 93	06	Test Reports	TAB report	1.5.6.1	G												
491			23 05 93	07	Certificates	TAB Firm	1.5.4.1	G												
492			23 05 93	07	Certificates	Independent TAB Agency and Personnel Qualifications	1.5.1	G												
493			23 07 00	03	Product Data	Certification														
494			23 07 00	03	Product Data	Pipe Insulation Systems	2.3	G												
495			23 07 00	03	Product Data	Pipe Insulation Systems	3.2	G												
496			23 07 00	03	Product Data	Duct Insulation Systems	3.3	G												
497			23 07 00	03	Product Data	Equipment Insulation Systems	3.4	G												
498			23 08 00.00 10	02	Shop Drawings	Commissioning Plan	1.5.2.2	G												
499			23 08 00.00 10	03	Product Data	Pre-Functional Performance Test Checklists	3.2.1	G												
500			23 08 00.00 10	03	Product Data	Functional Performance Tests	3.2.2	G												
501			23 08 00.00 10	06	Test Reports	Commissioning Report	3.3													
502			23 08 00.00 10	07	Certificates	Commissioning Firm	1.5.1													
503			23 08 00.00 10	07	Certificates	Commissioning Specialist	1.5.2													
504			23 54 16.00 10	02	Shop Drawings	Detail Drawings	1.3													
505			23 54 16.00 10	02	Shop Drawings	Installation	3.2													
506			23 54 16.00 10	03	Product Data	Spare Parts														
507			23 54 16.00 10	06	Test Reports	Testing, Adjusting, and Balancing	3.4													
508			23 54 16.00 10	10	Operation and Maintenance Data	Operation and Maintenance Instructions	3.3													
509			23 81 00.00 20	03	Product Data	Heat pumps	2.1													
510			23 81 00.00 20	03	Product Data	Thermostats	2.1.4													
511			23 81 00.00 20	03	Product Data	Refrigerant piping and accessories	2.3													
512			23 81 00.00 20	08	Manufacturer's Instructions	Heat pumps	2.1													
513			23 81 00.00 20	10	Operation and Maintenance Data	Heat pumps	2.1													
514			23 81 00.00 20	10	Operation and Maintenance Data	Thermostats	2.1.4													
515			23 81 00.00 20	11	Closeout Submittals	Posted operating instructions	1.4.4													
516			26 20 00	02	Shop Drawings	Panelboards	2.11													
517			26 20 00	02	Shop Drawings	Transformers	2.12													
518			26 20 00	02	Shop Drawings	Cable trays	2.3													
519			26 20 00	02	Shop Drawings	Marking strips	3.1.10.1													
520			26 20 00	03	Product Data	Receptacles	2.10													
521			26 20 00	03	Product Data	Circuit breakers	2.11.3													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
522			26 20 00	03	Product Data	Switches	2.9													
523			26 20 00	03	Product Data	Transformers	2.12													
524			26 20 00	03	Product Data	Motor controllers	2.14													
525			26 20 00	03	Product Data	Manual motor starters	2.15													
526			26 20 00	03	Product Data	Grounding Busbar	2.18.3													
527			26 20 00	03	Product Data	Surge protective devices	2.24													
528			26 20 00	06	Test Reports	600-volt wiring test	3.5.2													
529			26 20 00	06	Test Reports	Grounding system test	3.5.5													
530			26 20 00	06	Test Reports	Transformer tests	3.5.3													
531			26 20 00	06	Test Reports	Ground-fault receptacle test	3.5.4													
532			26 20 00	09	Manufacturer's Field Reports	Transformer factory tests	2.26.1													
533			26 20 00	10	Operation and Maintenance Data	Electrical Systems	1.5.1													
534			26 35 43	02	Shop Drawings	Frequency converter drawings	1.4.1													
535			26 35 43	03	Product Data	Frequency converter	2.1													
536			26 35 43	06	Test Reports	Work Plan	1.4.3													
537			26 35 43	06	Test Reports	Routine Factory Test Plan	1.4.4													
538			26 35 43	06	Test Reports	Special Factory Test Plan	1.4.5													
539			26 35 43	06	Test Reports	Performance Test Plan	1.4.6													
540			26 35 43	06	Test Reports	Test Schedule	2.2.1													
541			26 35 43	06	Test Reports	Routine Factory Tests	1.4.8													
542			26 35 43	06	Test Reports	Routine Factory Tests	2.2.2													
543			26 35 43	06	Test Reports	Special Factory Tests	1.4.9													
544			26 35 43	06	Test Reports	Special Factory Tests	2.2.3													
545			26 35 43	07	Certificates	Qualifications of manufacturer	1.4.2													
546			26 35 43	07	Certificates	UL Listing	1.4.7													
547			26 35 43	09	Manufacturer's Field Reports	Initial Inspection and Tests	3.2.3													
548			26 35 43	09	Manufacturer's Field Reports	Performance Tests	1.4.10													
549			26 35 43	09	Manufacturer's Field Reports	Performance Tests	3.2.4													
550			26 35 43	09	Manufacturer's Field Reports	Training Syllabus	3.3.1													
551			26 35 43	10	Operation and Maintenance Data	Frequency converter	2.1													
552			26 35 43	10	Operation and Maintenance Data	Preliminary Operation and Maintenance Manuals	1.5.1.2													
553			26 41 00	02	Shop Drawings	Overall lightning protection system	1.4.1.1													
554			26 41 00	02	Shop Drawings	Each major component	1.4.1.2													
555			26 41 00	06	Test Reports	Lightning Protection and Grounding System Test Plan	1.4.3													
556			26 41 00	06	Test Reports	Lightning Protection and Grounding System Test	3.5.1													
557			26 41 00	07	Certificates	Lightning Protection System Installers Documentation	1.2.3													
558			26 41 00	07	Certificates	Component UL Listed and Labeled	1.4.2													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
559			26 41 00	07	Certificates	Lightning protection system inspection certificate	1.4.4													
560			26 41 00	07	Certificates	Roof manufacturer's warranty	3.1.1													
561			26 42 14.00 10	02	Shop Drawings	Drawings	1.4.6													
562			26 42 14.00 10	02	Shop Drawings	Contractor's Modifications	1.2.1													
563			26 42 14.00 10	03	Product Data	Equipment	1.2													
564			26 42 14.00 10	03	Product Data	Spare Parts	1.6													
565			26 42 14.00 10	06	Test Reports	Tests and Measurements	3.5													
566			26 42 14.00 10	06	Test Reports	Contractor's Modifications	1.2.1													
567			26 42 14.00 10	07	Certificates	Cathodic Protection System	1.2													
568			26 42 14.00 10	07	Certificates	Services of 'Corrosion Expert'	1.4.1													
569			26 42 14.00 10	10	Operation and Maintenance Data	Cathodic Protection System	1.2													
570			26 42 14.00 10	10	Operation and Maintenance Data	Training Course	3.6													
571			26 51 00	03	Product Data	Fluorescent lighting fixtures	2.1													
572			26 51 00	03	Product Data	Fluorescent electronic ballasts	1.6.1													
573			26 51 00	03	Product Data	Fluorescent lamps	2.1.3													
574			26 51 00	03	Product Data	High-intensity-discharge (HID) lighting fixtures	2.2													
575			26 51 00	03	Product Data	HID ballasts	2.2.1													
576			26 51 00	03	Product Data	High-pressure sodium (HPS) lamps	2.2.2	G												
577			26 51 00	03	Product Data	Low-pressure sodium lamps	2.2.3	G												
578			26 51 00	03	Product Data	Metal-halide lamps	2.2.4													
579			26 51 00	03	Product Data	Lighting contactor	2.5													
580			26 51 00	03	Product Data	Photocell switch	2.6													
581			26 51 00	03	Product Data	Exit signs	2.7													
582			26 51 00	03	Product Data	Emergency lighting equipment	2.8													
583			26 51 00	03	Product Data	Occupancy sensors	2.10													
584			26 51 00	03	Product Data	Electronic dimming ballast	2.1.2													
585			26 51 00	03	Product Data	Energy Efficiency	1.6.3.2													
586			26 51 00	06	Test Reports	Operating test	3.3													
587			26 51 00	10	Operation and Maintenance Data	Lighting Control System	1.4.1													
588			28 31 64.00 10	02	Shop Drawings	Detail Drawings	1.3.2													
589			28 31 64.00 10	03	Product Data	Storage Batteries	2.5													
590			28 31 64.00 10	03	Product Data	Low Battery Voltage	2.1.2													
591			28 31 64.00 10	03	Product Data	Special Tools and Spare Parts	1.6													
592			28 31 64.00 10	03	Product Data	Technical Data and Computer Software	1.4													
593			28 31 64.00 10	03	Product Data	Training	3.6													
594			28 31 64.00 10	03	Product Data	Testing	3.7													
595			28 31 64.00 10	06	Test Reports	Testing	3.7													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
596			28 31 64.00 10	07	Certificates	Equipment	2.1.6													
597			28 31 64.00 10	07	Certificates	Qualifications	1.3.1													
598			28 31 64.00 10	10	Operation and Maintenance Data	Operating and Maintenance Instructions	3.6													
599			31 00 00	06	Test Reports	Testing	3.16													
600			31 00 00	07	Certificates	Testing	3.16													
601			31 31 16.13	03	Product Data	Termiticide Application Plan	3.3.6	G[												
602			31 31 16.13	03	Product Data	Termiticides	2.1													
603			31 31 16.13	03	Product Data	Foundation Exterior	3.3.3													
604			31 31 16.13	03	Product Data	Utilities and Vents	3.3.4													
605			31 31 16.13	03	Product Data	Crawl and Plenum Air Spaces	3.3.5													
606			31 31 16.13	03	Product Data	Verification of Measurement	3.1													
607			31 31 16.13	03	Product Data	Application Equipment	3.4.1													
608			31 31 16.13	03	Product Data	Warranty	1.6													
609			31 31 16.13	04	Samples	Termiticides	2.1													
610			31 31 16.13	06	Test Reports	Equipment Calibration and Tank Measurement	3.4.1													
611			31 31 16.13	06	Test Reports	Soil Moisture	1.5.1													
612			31 31 16.13	06	Test Reports	Quality Assurance	1.3													
613			31 31 16.13	07	Certificates	Qualifications	1.3.1													
614			32 11 23	06	Test Reports	Field Density Tests	1.5.2.4													
615			32 13 13.06	03	Product Data	Curing materials	2.1.6	G RO												
616			32 13 13.06	03	Product Data	Admixtures	2.1.4	G RO												
617			32 13 13.06	03	Product Data	Dowel	2.1.5.1	G RO												
618			32 13 13.06	03	Product Data	Reinforcement	2.1.5.4	G RO												
619			32 13 13.06	03	Product Data	Cementitious Materials	2.1.1	G RO												
620			32 13 13.06	03	Product Data	Aggregate	2.1.3	G RO												
621			32 13 13.06	05	Design Data	mix design	2.2	G RO												
622			32 13 13.06	06	Test Reports	Aggregate	2.1.3	G RO												
623			32 13 13.06	06	Test Reports	Concrete slump tests	3.7.2	G RO												
624			32 13 13.06	06	Test Reports	Air content tests	3.7.4	G RO												
625			32 13 13.06	06	Test Reports	Flexural strength tests	3.7.3	G RO												
626			32 13 13.06	06	Test Reports	Cementitious materials	2.1.1	G RO												
627			32 13 13.06	07	Certificates	Ready-mixed concrete plant	1.4.1	G RO												
628			32 13 13.06	07	Certificates	Batch tickets	1.4.3	G RO												
629			32 13 13.06	07	Certificates	Cementitious materials	2.1.1	G RO												
630			32 17 23.00 20	03	Product Data	Reflective media for roads and streets	2.1.2													
631			32 17 23.00 20	03	Product Data	Paints for roads and streets	2.1.1													
632			32 17 23.00 20	03	Product Data	Thermoplastic compound	2.1.3													
633			32 17 23.00 20	03	Product Data	Thermoplastic compound	3.2.2.3													

TITLE:	REPAIR MAINTENANCE HANGAR 456
JOB NAME:	
LOCATION:	COLUMBUS AFB, MISSISSIPPI
CONTRACT NO:	EEPZ 10-1001
CONTRACTOR:	

SUBMITTAL REGISTER

									CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					
	(a)	(b)	(c)	(d)			(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
634			32 17 23.00 20	03	Product Data	Raised Pavement Markers	2.1.5													
635			32 17 23.00 20	08	Manufacturer's Instructions	Paints for roads and streets	2.1.1													
636			32 17 23.00 20	08	Manufacturer's Instructions	Thermoplastic compound	2.1.3													
637			32 17 23.00 20	08	Manufacturer's Instructions	Thermoplastic compound	3.2.2.3													
638			32 92 19	03	Product Data	Fertilizer	2.4													
639			32 92 19	06	Test Reports	Topsoil composition tests	2.2.3													
640			32 92 19	07	Certificates	seed	2.1													
641			32 92 19	08	Manufacturer's Instructions	Erosion Control Materials	2.7													
642			33 11 00	03	Product Data	Piping Materials	2.1.1													
643			33 11 00	03	Product Data	Water distribution main	2.1													
644			33 11 00	03	Product Data	Water service line	2.2													
645			33 11 00	03	Product Data	Hydrants	2.1.2.6													
646			33 11 00	03	Product Data	Indicator posts	2.1.2.7													
647			33 11 00	03	Product Data	Corporation stops	2.2.2.1													
648			33 11 00	03	Product Data	Valve boxes	2.1.2.8													
649			33 11 00	03	Product Data	Valve boxes	2.2.2.6													
650			33 11 00	06	Test Reports	Disinfection	2.2.2.10													
651			33 11 00	07	Certificates	Water distribution main	2.1													
652			33 11 00	07	Certificates	Water service line	2.2													
653			33 11 00	07	Certificates	Lining	2.1.1.1													
654			33 11 00	07	Certificates	hydrants	2.1.2.6													
655			33 11 00	07	Certificates	Compound Type Meters	2.2.2.8													
656			33 30 00	02	Shop Drawings	Drawings	1.4.1													
657			33 30 00	02	Shop Drawings	Precast concrete manhole	2.2.1													
658			33 30 00	02	Shop Drawings	Metal items	2.2.4													
659			33 30 00	02	Shop Drawings	Frames, covers, and gratings	2.2.4.1													
660			33 30 00	03	Product Data	Pipeline materials	2.1													
661			33 30 00	06	Test Reports	Reports	2.3													

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.

ACOUSTICAL SOCIETY OF AMERICA (ASA)
1305 Walt Whitman Road, Suite 300
Melville, NY 11747-4300
Ph: 516-576-2360
Fax: 631-923-2875
E-mail: asa@aip.org
Internet: http://asa.aip.org

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 ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Office Square, Suite 550
Schaumburg, IL 60173-4268
Ph: 847-303-5664
Fax: 847-303-5774
E-mail: customerservice@aamanet.org
Internet: http://www.aamanet.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 ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
1 Davis Drive
P.O. Box 12215
Research Triangle Park, NC 27709-2215
Ph: 919-549-8141
Fax: 919-549-8933
Internet: http://www.aatcc.org

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
2025 M Street, NW, Suite 800
Washington, DC 20036
Ph: 202-367-1155
E-mail: info@americanbearings.org
Internet: http://www.americanbearings.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 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 SOCIETY OF SANITARY ENGINEERING (ASSE)
18927 Hickory Creek Drive, Suite 220
Mokena, IL 60448
Ph: 708-995-3019
Fax: 708-479-6139
E-mail: staffengineer@asse-plumbing.org
Internet: http://www.asse-plumbing.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 COUNCIL (AWC)
222 Catoctin Circle SE, Suite 201
Leesburg, VA 20175
Ph: 800-890-7732
Fax: 412-741-0609
E-mail: publications@awc.org
Internet: http://www.awc.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

ARCHITECTURAL WOODWORK INSTITUTE (AWI)
46179 Westlake Drive, Suite 120
Potomac Falls, VA 20165
Ph: 571-323-3636
Fax: 571-323-3630
E-mail: info@awinet.org
Internet: http://www.awinet.org

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 ROOFING MANUFACTURER'S ASSOCIATION (ARMA)
750 National Press Building
529 14th Street, NW
Washington D.C. 20045
Ph: 202-591-2450
Fax: 202-591-2445
Internet: http://www.asphaltroofing.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/

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

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (Bay Area AQMD)
939 Ellis Street
San Francisco, CA 94109
Ph: 415-771-6000

Fax: 415-928-8560
E-Mail: publicrecords@baaqmd.gov
Internet: http://www.baaqmd.gov/

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/

CARPET AND RUG INSTITUTE (CRI)
P.O. Box 2048
Dalton, GA 30722-2048
Ph: 706-278-3176
Fax: 706-278-8835
Internet: http://www.carpet-rug.com

COPPER DEVELOPMENT ASSOCIATION (CDA)
Internet: http://www.copper.org

CSA GROUP (CSA)
178 Rexdale Blvd.
Toronto, ON, Canada M9W 1R3
Ph: 416-747-4044
Fax: 416-747-2510
E-mail: sales@csagroup.org
Internet: http://www.csagroup.org/us/en/home

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

GLASS ASSOCIATION OF NORTH AMERICA (GANA)
800 SW Jackson St., Suite 1500
Topeka, KS 66612-1200
Ph: 785-271-0208
E-mail: gana@glasswebsite.com
Internet: http://www.glasswebsite.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

GYPSUM ASSOCIATION (GA)
6525 Belcrest Road, Suite 480
Hyattsville, MD 20782
Ph: 301-277-8686
Fax: 301-277-8747
E-mail: info@gypsum.org
Internet: http://www.gypsum.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

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)
27 N. Wacker Dr. Suite 365
Chicago, IL 60606-2800
Ph: 613-233-1510
Fax: 613-482-9436
E-mail: enquiries@igmaonline.org
Internet: http://www.igmaonline.org

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)
4755 E. Philadelphia St.
Ontario, CA 91761
Ph: 909-472-4100
Fax: 909-472-4150
E-mail: iapmo@iapmo.org
Internet: http://www.iapmo.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 CONCRETE REPAIR INSTITUTE (ICRI)
10600 West Higgins Road, Suite 607
Rosemont, IL 60018
Ph: 847-827-0830
Fax: 847-827-0832
Internet: http://www.icri.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

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
1, ch. de la Voie-Creuse
Case Postale 56
CP 56 - CH-1211 Geneva 20
Switzerland
Ph: 41-22-749-01-11
Fax: 41-22-733-34-30
E-mail: central@iso.ch
Internet: http://www.iso.org

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)
1901 North Moore Street
Arlington, VA 22209-1762
Ph: 703-525-1695
Fax: 703-528-2148
Internet: http://www.safetyequipment.org/

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

MARBLE INSTITUTE OF AMERICA (MIA)
380 E. Lorain Street
Oberlin, OH 44074
Ph: 440-250-9222
Fax: 440-774-9222
E-mail: miainfo@marble-institute.com
Internet: http://www.marble-institute.com

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

MIDWEST ROOFING CONTRACTORS ASSOCIATION (MRCA)
8735 W Higgins Road
Suite 300
Chicago, IL 60631
Ph: 800-497-6722
Fax: 847-375-6473
E-mail: info@mrca.org
Internet: General Information: http://www.mrca.org

NACE INTERNATIONAL (NACE)
Houston, TX 77084-4906
Ph: 281-228-6223
Fax: 281-228-6300
E-mail: firstservice@nace.org
Internet: http://www.nace.org

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)
800 Roosevelt Road, Bldg C, Suite 312
Glen Ellyn, IL 60137
Ph: 630-942-6591
Fax: 630-790-3095
E-mail: wlewis7@cox.net(Wes Lewis,technical consultant)
Internet: http://www.naamm.org

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 FENESTRATION RATING COUNCIL (NFRC)
6305 Ivy Lane, Suite 140
Greenbelt, MD 20770
Ph: 301-589-1776
Fax: 301-589-3884
E-Mail: info@nfrc.org
Internet: http://www.nfrc.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 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

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)
272 Tuttle Road
Cumberland, ME 04021
Ph: 207-829-6901
Fax: 207-829-4293
E-mail: info@nelma.org
Internet: http://www.nelma.org

NSF INTERNATIONAL (NSF)
789 North Dixboro Road
P.O. Box 130140
Ann Arbor, MI 48105
Ph: 734-769-8010 or 800-NSF-MARK
Fax: 734-769-0109
E-mail: info@nsf.org
Internet: http://www.nsf.org

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)
800 Roosevelt Road
Building C, Suite 312
Glen Ellyn, IL 60137
Ph: 630-858-6540
Fax: 630-790-3095
Internet: http://www.ppfahome.org

PLUMBING AND DRAINAGE INSTITUTE (PDI)
800 Turnpike Street, Suite 300
North Andover, MA 01845
Ph: 978-557-0720 or 800-589-8956
E-Mail: pdi@PDIonline.org
Internet: http://www.pdionline.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

SINGLE PLY ROOFING INDUSTRY (SPRI)
411 Waverley Oaks Road, Suite 331B

Waltham, MA 02452
Ph: 781-647-7026
Fax: 781-647-7222
E-mail: info@spri.org
Internet: http://www.spri.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

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)
400 Commonwealth Drive
Warrendale, PA 15096
Ph: 724-776-4970
Fax: 877-606-7323
E-mail: customerservice@sae.org
Internet: http://www.sae.org

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
21865 Copley Drive
Diamond Bar, CA 91765
Ph: 909-396-2000
E-mail: webinquiry@aqmd.gov
Internet: http://www.aqmd.gov

SOUTHERN PINE INSPECTION BUREAU (SPIB)
P.O. Box 10915
Pensacola, FL 32504-0915
Ph: 850-434-2611
Fax: 850-433-5594
Internet: http://www.spib.org

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

TILE COUNCIL OF NORTH AMERICA (TCNA)
100 Clemson Research Boulevard
Anderson, SC 29625
Ph: 864-646-8453
Fax: 864-646-2821
E-mail: info@tileusa.com
Internet: http://www.tcnatile.com/

U.S. AIR FORCE (USAF)
Air Force Publishing Distribution Center
Ph: 202-404-2438Internet: http://www.e-publishing.af.mil/

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. 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

UL ENVIRONMENT (ULE)
2211 Newmarket Parkway, Suite 106
Marietta, GA 30067
Ph: 770-933-0638
Fax: 770-980-0072
E-mail: environment@ul.com
Intertet: http://www.ul.com/environment

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

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)
2711 LBJ Freeway, Suite 1000
Dallas, TX 75234
Ph: 972-243-3902
Fax: 972-243-3907
E-mail: info@uni-bell.org
Internet: http://www.uni-bell.org

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)
330 N Wabash Avenue, Suite 2000
Chicago, IL 60611
Ph: 312-321-6802
E-mail: wdma@wdma.com
Internet: http://www.wdma.com

WOOLMARK COMPANY (WBI)
Level 30, HSBC Centre
580 George St
Sydney NSW 2000
GPO Box 4177
Sydney, NSW, Australia 2001
Ph: 61 2 8295 3100
Fax: 61 2 8295 4100
E-mail: feedback@wool.com
internet: http://www.woolmark.com

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 45 00.10 20

QUALITY CONTROL
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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

1.2 INFORMATION FOR THE CONTRACTING OFFICER (CO)

Prior to commencing work on construction, the Contractor can obtain a single copy set of the current report forms from the CO. 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 CO:

a. CQC Report: Original and one copy, by 10:00 AM the next working dayafter each day that work is performed;

b. Contractor Production Report: Original and one copy by 10:00 AM the next working day after each day that work is performed;

c. Preparatory Phase Checklist: Original attached to the original CQC Report and one copy attached to each copy;

d. Initial Phase Checklist: Original attached to the original CQC Report and one copy attached to each copy;

e. Field Test Reports: One copy, within three working days after the test is performed, attached to the CQC Report;

f. QC Meeting Minutes: One copy, within three working days after the meeting; and

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

1.3 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Manager, a QC plan, a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this

contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the QC Manager is on the work site.

1.3.1 Preliminary Work Authorized Prior to Acceptance

The only 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.

1.3.2 Acceptance

Acceptance of the QC plan is required prior to the start of construction. The KO 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 KO reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications.

1.3.3 Notification of Changes

Notify the KO, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to the acceptance by the KO.

1.4 QC ORGANIZATION

1.4.1 QC Manager

1.4.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. In addition to implementing and managing the QC program, the QC Manager may perform the duties of project superintendent. The QC Manager is required to attend the 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 others.

1.4.1.2 Qualifications

An individual with a minimum of 5 years combined experience as a superintendent, inspector, QC Manager, project manager, or construction manager on similar size and type construction contracts which included the major trades that are part of this contract. The individual must be familiar with the requirements of the EM 385-1-1 and have experience in the areas of hazard identification and safety compliance.

1.4.1.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager shall have completed the course Construction Quality Management for Contractors and will have a current certificate.

1.4.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager to serve in the event of the

designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be the same as for the QC Manager.

1.5 QC PLAN

1.5.1 Requirements

Provide, for acceptance by the KO, a QC plan submitted in a three-ring binder that covers both on-site and off-site work and includes the following with a table of contents listing the major sections identified with tabs.

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

II. NAMES AND QUALIFICATIONS: In resume format, for each person in the QC organization. Include the CQM for Contractors course certification required by the paragraph entitled "Construction Quality Management Training".

III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONAL: Of each person in the QC organization.

IV. 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.

V. 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 managing and implementing the QC program as described in this contract. Include in this letter the QC Manager's authority to direct the removal and replacement of non-conforming work.

VI. 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.

VII. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraphs "Accredited Laboratories" or "Testing Laboratory Requirements", as applicable.

VIII. 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.

IX. PROCEDURES TO COMPLETE REWORK ITEMS: Procedures to identify, record, track and complete rework items.

X. DOCUMENTATION PROCEDURES: Use Government formats.

XI. LIST OF DEFINABLE FEATURES: A Definable Feature of Work (DFOW) is a task, which is separate and distinct from other tasks, has the same control requirements and work crews. The list shall be

cross-referenced to the Contractor's Construction Schedule and the specification sections. For projects requiring a Progress Chart, the list of definable features of work shall include but not be limited to all items of work on the schedule. For projects requiring a Network Analysis Schedule, the list of definable features of work shall include but not be limited to all critical path activities.

XII. PROCEDURES FOR PERFORMING THREE PHASES OF CONTROL: For each DFOW provide Preparatory and Initial Phase Checklists. Each list shall include a breakdown of quality checks that will be used when performing the quality control functions, inspections, and tests required by the contract documents. The preparatory and initial phases shall be conducted with a view towards obtaining quality construction by planning ahead and identifying potential problems.

XIII. PERSONNEL MATRIX: Not Applicable.

XIV. PROCEDURES FOR COMPLETION INSPECTION: See the paragraph entitled "COMPLETION INSPECTIONS".

XV. TRAINING PROCEDURES AND TRAINING LOG: Not Applicable.

1.6 COORDINATION AND MUTUAL UNDERSTANDING MEETING

During the Pre-Construction conference and prior to the start of construction, discuss the QC program required by this contract. 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, and the coordination of the Contractor's management, production and the QC personnel. At the meeting, the Contractor will be required to explain how three phases of control will be implemented for each DFOW. Contractor's personnel required to attend shall include the QC Manager, project manager, and superintendent. Minutes of the meeting will be prepared by the QC Manager and signed by both the Contractor and the KO. The Contractor shall provide a copy of the signed minutes to all attendees. Repeat the coordination and mutual understanding meeting when a new QC Manager is appointed.

1.7 QC MEETINGS

After the start of construction, the QC Manager shall conduct QC meetings once every two weeks at the work site with the superintendent and the foreman responsible for the ongoing and upcoming work. The QC Manager shall prepare the minutes of the meeting and provide a copy to the KO within two working days after the meeting. As a minimum, the following shall be accomplished at each meeting:

a. Review the minutes of the previous meeting;

b. Review the schedule and the status of work 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 (RFIs, etc.);

f. Address items that may require revising the QC plan; and

g. Review Accident Prevention Plan (APP).

1.8 THREE PHASES OF CONTROL

The three phases of control shall adequately cover both on-site and off-site work and shall include the following for each DFOW.

1.8.1 Preparatory Phase

Notify the KO at least two work days in advance of each preparatory phase. Conduct the preparatory phase with the superintendent and the foreman responsible for the definable feature of work. Document the results of the preparatory phase actions in the daily CQC Report and in the QC checklist. Perform the following prior to beginning work on each definable feature of work:

a. Review each paragraph of the applicable specification sections;

b. Review the contract drawings;

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

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

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

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

g. Review the 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; and

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

1.8.2 Initial Phase

Notify the KO 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 foreman responsible for that DFOW. Observe the initial segment of the work to ensure that it complies with contract requirements. Document the results of the Initial Phase in the daily CQC Report and in the QC checklist. 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; and

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

1.8.3 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 and in the QC checklist:

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; and

e. Assure manufacturers representatives have performed necessary inspections, if required.

1.8.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted 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.

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

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

1.9 SUBMITTAL REVIEW AND APPROVAL

Procedures for submission, review, and approval of submittals are described in the submittal section of the specification.

1.10 TESTING

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

1.10.1 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 (i.e.; 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."

1.10.2 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities include the National Voluntary

Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology, the American Association of State Highway and Transportation Officials (AASHTO), International Accreditation Services, Inc. (IAS), U. S. Army Corps of Engineers Materials Testing Center (MTC), the American Association for Laboratory Accreditation (A2LA), the Washington Association of Building Officials (WABO) (Approval authority for WABO is limited to projects within Washington State), and the Washington Area Council of Engineering Laboratories (WACEL) (Approval authority by WACEL is limited to projects within the NAVFAC WASH and Public Works Center Washington geographical area).

1.10.3 Capability Check

The KO 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.

1.10.4 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 KO 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 shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the KO.

1.11 QC CERTIFICATIONS

1.11.1 Contractor Quality Control Report Certification

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

1.11.2 Invoice Certification

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

1.11.3 Completion Certification

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

1.12 COMPLETION INSPECTIONS

1.12.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Contract clause "Commencement, Prosecution,

and Completion of Work," or stated elsewhere in the specifications, the QC Manager shall conduct an inspection of the work and develop a punch list of items which do not conform to the approved drawings and specifications. Include in the punch list any remaining items of the "Rework Items List", which were not corrected prior to the Punch-Out inspection. The punch list shall include the estimated date by which the deficiencies will be corrected. A copy of the punch list shall be provided to the KO. The QC Manager or staff shall make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government "Pre-Final Inspection".

1.12.2 Pre-Final Inspection

The Government and QC manager will perform this inspection to verify that the facility is complete and ready to be occupied. A Government pre-final punch list may be developed as a result of this inspection. The QC Manager shall ensure that all items on this list are corrected prior to notifying the Government that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-Final" inspection shall be corrected in a timely manner and shall 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.

1.12.3 Final Acceptance Inspection

The QC Manager, the superintendent, or other Contractor management personnel and the KO will be in attendance at this inspection. Additional Government personnel may be in attendance. The final acceptance inspection will be formally scheduled by the KO based upon results of the "Pre-Final Inspection". Notice shall be given to the KO at least 14 days prior to the final inspection. The notice shall state that all specific items previously identified to the Contractor as being unacceptable will be complete by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the KO to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause "Inspection of Construction".

1.13 DOCUMENTATION

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 (KO)" shall 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 superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. The reporting of work shall be identified by terminology consistent with the construction schedule. In the "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site. For each remark given, identify the Schedule Activity No. that is associated with the remark.

1.13.1 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 shall be readily available to the Government's Quality Assurance Team during all business hours.

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

b. All milestone inspections, arranged by Activity/Event Number.

c. A current up-to-date copy of the Testing and Plan 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. A current up-to-date copy of the Rework Items List.

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

1.13.2 As-Built Drawings

The QC Manager is required to review the as-built drawings, required by Section 01 78 00 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 number, modification number, RFI number, etc. The QC Manager shall initial each deviation or revision. Upon completion of work, the QC Manager shall submit a certificate attesting to the accuracy of the as-built drawings prior to submission to the KO.

1.14 NOTIFICATION ON NON-COMPLIANCE

The KO will notify the Contractor of any detected non-compliance with the foregoing requirements. The Contractor shall take immediate corrective action. If the contractor fails or refuses to correct the non-compliant work, the KO will issue a non compliance 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 KO may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall make no part of the time lost due to such stop orders the subject of claim for extension of time, for excess costs, or damages.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION
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. AIR FORCE (USAF)

AFI 32-1053	(2009) Integrated Pest Management Program

U.S. ARMY (DA)

DA AR 200-1	(2007) Environmental Protection and Enhancement

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 2011) Safety and Health Requirements Manual
WETLANDS DELINEATION MANUAL	(1987) Corps of Engineers Wetlands Delineation Manual

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

33 CFR 328	Definitions of Waters of the United States
40 CFR 150 - 189	Pesticide Programs
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 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
40 CFR 68	Chemical Accident Prevention Provisions
49 CFR 171 - 178	Hazardous Materials Regulations

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor must discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" must occur. Land Application must be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.5 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.

1.2.6 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.

1.2.7 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters

that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.8 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.9 Wetlands

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLANDS DELINEATION MANUAL.

1.3 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work must be protected 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.

1.4 SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. Payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor, and payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations are the Contractor's responsibility. All costs associated with this section must be included in the contract price.

1.6 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern must be defined within the Environmental Protection Plan as outlined in this section. Address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but are considered necessary, must be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the

Contractor's Environmental Plans. The Environmental Protection Plan must be current and maintained onsite by the Contractor.

1.6.1 Compliance

No requirement in this Section will relieve the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor will be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.6.2 Contents

Include in the environmental protection plan, but not limit it to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan must include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Include in the Spill Control plan the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1. Include in this plan, as a minimum:

(1) The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual will immediately notify the Contracting Officer and Facility Environmental Office in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. Include in the plan a list of the required reporting channels and telephone numbers.

(2) The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

(3) Training requirements for Contractor's personnel and methods of accomplishing the training.

(4) A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

(5) The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

(6) The methods and procedures to be used for expeditious contaminant cleanup.

j. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris and schedules for disposal.

(1) Identify any subcontractors responsible for the transportation and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility.

(2) Evidence of the disposal facility's acceptance of the solid waste must be attached to this plan during the construction.

(3) A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. Detail in the plan the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

k. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

l. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be onsite at any given time must be included in the

contaminant prevention plan. Update the plan as new hazardous materials are brought onsite or removed from the site.

m. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan must include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan must include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan must include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

n. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. Include in the plan methods to assure the protection of known or discovered resources, identifying lines of communication between Contractor personnel and the Contracting Officer.

o. 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" AFI 32-1053 Sections 3.4.13 and 3.4.14 for data required to be reported to the Installation.

1.6.3 Appendix

Attach to the Environmental Protection Plan, as an appendix, copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents.

1.7 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer will make a joint condition survey. Immediately following the survey, the Contractor will prepare a brief report including a plan describing the features requiring protection under the provisions of

the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report will be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor must protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the work under the contract.

1.8 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations from the drawings,plans and specifications, requested by the Contractor and which may have an environmental impact, will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.9 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. After receipt of such notice, the Contractor will inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or equitable adjustments allowed for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

Obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations is the Contractor's responsibility.

3.2 LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Identify any land resources to be preserved within the work area prior to the beginning of any construction. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval, except in areas indicated on the drawings or specified to be cleared. Ropes, cables, or guys will not be fastened to or attached to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times, as defined in the following

subparagraphs. Remove stone, soil, or other materials displaced into uncleared areas.

3.2.1 Work Area Limits

Mark the areas that need not be disturbed under this contract prior to commencing construction activities. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. The Contractor's personnel must be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved must be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Erosion and Sediment Controls

Providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations is the Contractor's responsibility. Select and maintain the erosion and sediment controls such that water quality standards are not violated as a result of construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. Construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Remove any temporary measures after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities will be made only when approved. Erosion and sediment controls must be provided for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas must be controlled to protect adjacent areas.

3.3 WATER RESOURCES

Monitor all water areas affected by construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. For construction activities immediately adjacent to impaired surface waters, the Contractor must be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.4 AIR RESOURCES

Equipment operation, activities, or processes will be in accordance with

all Federal and State air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; must be controlled at all times, including weekends, holidays and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities must be controlled at all times. The odors must be in compliance with State regulations and/or local ordinances and may not constitute a health hazard.

3.4.3 Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise.

3.4.4 Burning

Burning is prohibited on the Government premises.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes will be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Solid Wastes

Place solid wastes (excluding clearing debris) in containers which are emptied on a regular schedule. Handling, storage, and disposal must be conducted to prevent contamination. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with solid waste. Transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill will be the minimum acceptable offsite solid waste disposal option. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

3.5.2 Chemicals and Chemical Wastes

Dispense chemicals ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. This documentation will be periodically

reviewed by the Government. Collect chemical waste in corrosion resistant, compatible containers. Collection drums must be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes will be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. At a minimum, manage and store hazardous waste in compliance with 40 CFR 262. Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. Segregate hazardous waste from other materials and wastes, protect it from the weather by placing it in a safe covered location, and take precautionary measures such as berming or other appropriate measures against accidental spillage. Storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations is the Contractor's responsibility. Transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. Dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials must be immediately reported to the Contracting Officer and the Facility Environmental Office. Cleanup and cleanup costs due to spills are the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles must be conducted in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded must be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Storage of fuel on the project site is not allowed. Fuel must be brought to the project site each day that work is performed.

3.5.5 Waste Water

Disposal of waste water will be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. will not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. Dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

3.6 RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project.

3.7 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources will be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in impact to or the destruction of these resources. Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.8 BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The protection of threatened and endangered animal and plant species, including their habitat, is the Contractor's responsibility in accordance with Federal, State, Regional, and local laws and regulations.

3.9 INTEGRATED PEST MANAGEMENT

For termiticide requirements see Section 31 31 16.13 SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL. The use and management of pesticides are regulated under 40 CFR 150 - 189.

3.10 PREVIOUSLY USED EQUIPMENT

Clean all previously used construction equipment prior to bringing it onto the project site. Ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the USDA jurisdictional office for additional cleaning requirements.

3.11 MAINTENANCE OF POLLUTION FACILITIES

Maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.12 MILITARY MUNITIONS

In the event military munitions, as defined in 40 CFR 260, are discovered or uncovered, the Contractor will immediately stop work in that area and immediately inform the Contracting Officer.

3.13 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel must be trained in all phases of environmental protection and pollution control. Conduct environmental protection/pollution control meetings for all personnel prior to commencing construction activities. Additional meetings must be conducted for new personnel and when site conditions change. Include in the training and meeting agenda: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards;

installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.14 POST CONSTRUCTION CLEANUP

The Contractor will clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area must be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE
05/14

PART 1 GENERAL

1.1 SUMMARY

Perform all work in accordance withACI 318.

1.2 UNIT PRICES

1.2.1 Concrete Payment

Payment will cover all costs associated with manufacturing, furnishing, delivering, placing, finishing, and curing of concrete for the various items of the schedule, including the cost of all formwork. Payment for concrete, for which payment is made as a lump sum, is to be included in this unit price payment item. Payment for grout, preformed expansion joints, field-molded sealants, waterstops, reinforcing steel bars or wire reinforcement is to be included in this unit price payment item.

1.2.2 Measurement

Concrete will be measured for payment on the basis of the actual volume of concrete within the pay lines of the structures as indicated. Measurement of concrete placed against the sides of any excavation without the use of intervening forms will be made only within the pay lines of the structure. No deductions will be made for rounded or beveled edge, for space occupied by metal work, for electrical conduits or timber, or for voids or embedded items that are either less than 5 cubic feet in volume or 1 square foot in cross section.

1.2.3 Unit of Measure

Unit of measure: cubic yard.

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 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	(2011; Errata 1 2011; Errata 2 2012; Errata 3-4 2013) Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2013) 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 C143/C143M	(2012) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2014) 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 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 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 C685/C685M	(2011) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2014a) Standard Specification for Ready-Mixed Concrete
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D412	(2006a; R 2013) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D471	(2012a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates
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)

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

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

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

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. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. 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
Water-Reducing or Retarding Admixture
Curing Materials
Batching and Mixing Equipment
Conveying and Placing Concrete
Mix Design Data; G
Ready-Mix Concrete
Curing Compound
Mechanical Reinforcing Bar Connectors

SD-06 Test Reports

Aggregates
Concrete Mixture Proportions; G

Water

SD-07 Certificates

Cementitious Materials
Pozzolan
CPG for recycled materials or appropriate Waiver Form
Aggregates
Delivery Tickets

SD-08 Manufacturer's Instructions

Chemical Floor Hardener
Curing Compound

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The Government retains the option to sample and test joint sealer, joint filler material, waterstop, 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 . Provide a minimum of five specimens from each sample; two to be tested at 28 days (90 days if pozzolan is used) 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 two specimens tested at 28 days (90 days if pozzolan is used). 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 "C" finish to all surfaces except those specified to receive a Class "D" finish. Apply a Class "D" finish to all post-construction surfaces 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 3,000 psi at 28 days (90 days if pozzolan is used). 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 0.50 . 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 I, 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.

2.2.1.2 Pozzolan

Provide pozzolan that conforms to ASTM C618, Class F, including requirements of Tables 1A and 2A.

2.2.2 Aggregates

For fine and coarse aggregates meet the quality and grading requirements of ASTM C33/C33M. 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 Water-Reducing or Retarding Admixture

Provide water-reducing or retarding admixture meeting the requirements of ASTM C494/C494M, Type A, B, or D. High-range water reducing admixture Type F may be used only when approved, approval being contingent upon particular placement requirements as described in the Contractor's Quality Control Plan.

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 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded of sponge rubber conforming to ASTM D1752, Type I.

2.2.7 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.

2.2.8 Form Coatings

Provide form coating in accordance with ACI 301.

2.2.9 Curing Materials

Provide 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 Waterstops

2.4.1.1 PVC Waterstop

Polyvinylchloride waterstops conforming to COE CRD-C 572.

2.4.1.2 Rubber Waterstop

Rubber waterstops conforming to COE CRD-C 513.

2.4.1.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops conforming to ASTM D471.

2.4.1.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water conforming to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Minimum hardness of 50 on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F; 3 to 1 minimum.

2.4.2 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.

2.4.3 Curing Compound

Provide curing compound conforming to ASTM C309. Submit manufactures instructions for placing curing compound.

PART 3 EXECUTION

3.1 PREPARATION

Prepare construction joints to expose coarse aggregate. The surface nust 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 Production of Concrete

3.1.3.1 Ready-Mixed Concrete

Provide ready-mixed concrete conforming to ASTM C94/C94M except as otherwise specified.

3.1.3.2 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, Section 5.

FINISH	LOCATION
Float	
Trowel	
Broom or Belt	

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

3.3.3.1.2 Subject to Vehicular Traffic

Floor slabs on grade subject to vehicular traffic or receiving thin-set flooring shall conform to the following ACI F-number requirements:

Specified Overall Values	FF35/FL25 minimum
Minimum Local Values	FF25/FL17 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. Provide expansion joints at a maximum spacing of 30 feet on center in sidewalks , unless otherwise indicated. Provide contraction joints at a maximum spacing of 6 linear feet in sidewalks 10, unless otherwise indicated. Cut contraction joints at a minimum of 10 inch(es) deep with a jointing tool after the surface has been finished.

3.4 CURING AND PROTECTION

Cure and protect 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 where indicated, 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. ProvObtain 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 100 cubic yards of concrete. Test two cylinders at 7

days; two cylinders at 28 days; and hold two cylinders in reserve. Conform test specimens to ASTM C31/C31M. Perform compressive strength testing conforming to ASTM C39/C39M.

c. Test slump at the site of discharge for each design mix in accordance with ASTM C143/C143M. Check slump once during each shift that concrete is produced .

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 .

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 .

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 04 20 00

MASONRY
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.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 530/530.1	(2013) Building Code Requirements and Specification for Masonry Structures and Related Commentaries
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 A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A615/A615M	(2014) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A641/A641M	(2009a; R 2014) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM B633	(2013) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C1019	(2013) Standard Test Method for Sampling and Testing Grout
ASTM C129	(2014) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C270	(2014) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2010) Standard Specification for Grout for Masonry
ASTM C494/C494M	(2013) Standard Specification for Chemical Admixtures for Concrete

ASTM C593	(2006; R 2011) Fly Ash and Other Pozzolans for Use with Lime for Soil Stabilization
ASTM C641	(2009) Staining Materials in Lightweight Concrete Aggregates
ASTM C780	(2014a) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C90	(2014) Loadbearing Concrete Masonry Units
ASTM C94/C94M	(2014b) Standard Specification for Ready-Mixed Concrete
ASTM D2000	(2012) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2240	(2005; R 2010) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2287	(2012) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED BD+C	(2009; R 2010) Leadership in Energy and Environmental Design(tm) Building Design and Construction (LEED-NC)

1.2 SYSTEM DESCRIPTION

1.2.1 Design Requirements

1.2.1.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method", ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

1.2.1.2 Masonry Strength

Determine masonry strength in accordance with ACI 530/530.1; submit test reports on three prisms as specified in ACI 530/530.1. The cost of testing shall be paid by the Contractor.

1.2.2 Additional Requirements

a. Maintain at least one spare vibrator on site at all times.

b. Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

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.] [information only. When used, a designation following the "G"

designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Cement; G; (LEED BD+C)

Cold Weather Installation; G

Water-Repellant Admixture; G

SD-04 Samples

Concrete Masonry Units (CMU); G

Anchors, Ties, and Bar Positioners; G
Expansion-Joint Materials; G
Joint Reinforcement; G

SD-05 Design Data

Pre-mixed Mortar; G
Unit Strength Method; G

SD-06 Test Reports

Field Testing of Mortar; G
Field Testing of Grout; G

Masonry Cement; G

Masonry Inspector Qualifications; G
Single-Wythe Masonry Wall Water Penetration Test

SD-07 Certificates

Concrete Masonry Units (CMU)
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Joint Reinforcement
Masonry Cement

Admixtures for Masonry Mortar
Admixtures for Grout

Contamination

SD-08 Manufacturer's Instructions

Masonry Cement

1.4 QUALITY ASSURANCE

1.4.1 Masonry Inspector Qualifications

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 2 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction. Submit copies of masonry inspector reports.

1.4.2 Detail Drawings

Submit detail drawings showing bar splice locations. . Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered, stored, handled, and protected to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.5.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C90. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and

bottom bars.

1.5.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.5.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination or segregation.

1.6 PROJECT/SITE CONDITIONS

Conform to ACI 530/530.1 for hot and cold weather masonry erection.

1.6.1 Hot Weather Installation

Take the following precautions if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

1.6.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, submit a written statement of proposed cold weather construction procedures for approval.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. Submit sample of colored mortar with applicable masonry unit and color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture. Submit test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2 CONCRETE MASONRY UNITS (CMU)

Submit samples and certificates as specified. Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions

and air, water, or steam cured. ; . Exterior concrete masonry units shall have water-repellant admixture added during manufacture.

b. Hollow Non-Load-Bearing Units: ASTM C129, made with lightweight or medium weight or normal weight aggregate. Load-bearing units may be provided in lieu of non-load-bearing units.

2.2.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.2.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.3 MORTAR FOR STRUCTURAL MASONRY

ASTM C270, Type N . Strength (f'm) as indicated. Test in accordance with ASTM C780. Use Type I portland cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 18 percent in masonry cement mortar. Use up to 40 percent Class F fly ash with type IP cement in cement-lime mortar. Fly ash shall comply with ASTM C593.

2.4 WATER-REPELLANT ADMIXTURE

Polymeric type formulated to reduce porosity and water penetration and water absorption of the mortar and masonry units .

2.5 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C476, fine . Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 11 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C1019. Use grout subject to the limitations of Table III. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C94/C94M.

2.5.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to

ASTM C494/C494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer. Submit required certifications.

2.5.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.6 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A153/A153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A1064/A1064M. Wire ties or anchors in exterior walls shall conform to ASTM A641/A641M. Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face. Submit two anchors, ties and bar positioners of each type used, as samples.

2.6.1 Wire Mesh Ties

Wire mesh for tying 4 inch thick concrete masonry unit partitions to other intersecting masonry partitions shall be 1/2 inch mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 12 inches.

2.6.2 Wall Ties

Provide wall ties rectangular-shaped or Z-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.6.3 Dovetail Anchors

Provide dovetail anchors of the flexible wire type, 3/16 inch diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. Use these anchors for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Fill cells within vertical planes of these anchors solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section .

2.6.4 Adjustable Anchors

Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall

be cleaned and given one coat of zinc-rich touch up paint.

2.6.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell. Telescoping bar positioner shall be manufactured from AISI 1065 spring steel and coated in accordance with ASTM B633.

2.7 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A1064/A1064M, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A153/A153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.8 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A615/A615M, Grade 60.

2.9 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D2000or polyvinyl chloride conforming to ASTM D2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D2240.

2.10 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07 92 00 JOINT SEALANTS. Submit one piece of each type of material used.

2.11 THROUGH WALL FLASHING

Provide Through Wall Flashing as specified in Section 07 60 00 FLASHING AND SHEET METAL. Provide one of the following types

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530/530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

3.1.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

3.1.1.1 Air Temperature 40 to 32 Degrees F

Heat sand or mixing water to produce mortar temperatures between 40 and 120 degrees F

3.1.1.2 Air Temperature 32 to 25 Degrees F

Heat sand and mixing water to produce mortar temperatures between 40 and 120 degrees F. Maintain temperature of mortar on boards above freezing.

3.1.1.3 Air Temperature 25 to 20 Degrees F

Heat sand and mixing water to provide mortar temperatures between 40 and 120 degrees F. Maintain temperature of mortar on boards above freezing. Use sources of heat on both sides of walls under construction. Employ windbreaks when wind is in excess of 15 mph.

3.1.1.4 Air Temperature 20 Degrees F and Below

Heat sand and mixing water to provide mortar temperatures between 40 and 120 degrees F. Provide enclosure and auxiliary heat to maintain air temperature above 32 degrees F. Temperature of units when laid must not be less than 20 degrees F.

3.1.2 Completed Masonry and Masonry Not Being Worked On

3.1.2.1 Mean Daily Air Temperature 40 to 32 Degrees F

Protect masonry from rain or snow for 24 hours by covering with weather-resistive membrane.

3.1.2.2 Mean Daily Air Temperature 32 to 25 Degrees F

Completely cover masonry with weather-resistant membrane for 24 hours.

3.1.2.3 Mean Daily Air Temperature 25 to 20 Degrees F

Completey cover masonry with insulating blankets or equally protected for 24 hours.

3.1.2.4 Mean Daily Temperature 20 Degrees F and Below

Maintain masonry temperature above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps,

or other approved methods.

3.1.3 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.1.5 Surfaces

Clean surfaces on which masonry is to be placed of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic.

b. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb.

c. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

d. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Tolerances

Lay masonry plumb, true to line, with courses level. Keep bond pattern plumb throughout. Square corners unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, lay masonry within the following tolerances (plus or minus unless otherwise noted):

TABLE II TOLERANCES	
Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch

TABLE II TOLERANCES	
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.5 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.6 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.6.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.6.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave . Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.6.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.7 Joint Widths

Joint widths shall be as follows:

3.2.7.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

3.2.8 Embedded Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout.

3.2.9 Unfinished Work

Step back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.2.10 Masonry Wall Intersections

Masonry bond each course at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond

beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.11 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 4 inch nominal thick units shall be tied to intersecting partitions of 4 inch units, 5 inches into partitions of 6 inch units, and 7 inches into partitions of 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 MORTAR MIX

Mix mortar in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measure ingredients for mortar by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Mix water with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Retemper mortar that has stiffened because of loss of water through evaporation by adding water to restore the proper consistency and workability. Discard mortar that has reached its initial set or that has not been used within 2.5 hours after mixing.

3.4 REINFORCING STEEL

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.4.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.4.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.5 JOINT REINFORCEMENT INSTALLATION

Install joint reinforcement at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement to provide not less than 5/8 inch cover to either face of the unit.

3.6 PLACING GROUT

Fill cells containing reinforcing bars with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.6.1 Vertical Grout Barriers for Fully Grouted Walls

Provide grout barriers not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.6.2 Horizontal Grout Barriers

Embed grout barriers in mortar below cells of hollow units receiving grout.

3.6.3 Grout Holes and Cleanouts

3.6.3.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.6.3.2 Cleanouts for Hollow Unit Masonry Construction

Provide cleanout holes at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final

cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.6.4 Grouting Equipment

3.6.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Operate pumps to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.6.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. Maintain at least one spare vibrator at the site at all times. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.6.5 Grout Placement

Lay masonry to the top of a pour before placing grout. Do no place grout in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.6.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.6.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and

placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III
POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

			Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells in inches (1,2)	
Maximum Grout Pour Height feet (4)	Grout Type	Grouting Procedure	Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:
(1) The actual grout space or cell dimension shall be larger than the sum of the following items:

(a) The required minimum dimensions of total clear areas given in the table above;
(b) The width of any mortar projections within the space;
(c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.7 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.8 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using sash jamb units with control joint key in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07 92 00 JOINT SEALANTS. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.9 LINTELS

3.9.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.10 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.10.1 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with

adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

3.11 PARGING

The outside face of below-grade exterior concrete-masonry unit walls enclosing usable rooms and spaces, except crawl spaces, shall be parged with type S mortar. Parging shall not be less than 1/2 inch thick troweled to a smooth dense surface so as to provide a continuous unbroken shield from top of footings to a line 6 inches below adjacent finish grade, unless otherwise indicated. Parging shall be coved at junction of wall and footing. Parging shall be damp-cured for 48 hours or more before backfilling. Parging shall be protected from freezing temperatures until hardened.

3.12 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs or splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.12.1 Dry-Brushing

a. Exposed concrete masonry unit

b. Exposed

c. shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.13 BEARING PLATES

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section [03 30 00.00 10 CAST-IN-PLACE CONCRETE] [03 30 00 CAST-IN-PLACE CONCRETE].

3.14 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.15 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

3.16 TEST REPORTS

3.16.1 Field Testing of Mortar

Take at least three specimens of mortar each day. Spread a layer of mortar 1/2 to 5/8 inch thick on the masonry units and allowed to stand for one minute. Prepare and test the specimens for compressive strength in accordance with ASTM C780. Submit test results.

3.16.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days. Submit test results.

-- 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 A29/A29M	(2013) Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
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) 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	(2013a) 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	(2013) 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 F436	(2011) Hardened Steel Washers
ASTM F844	(2007a; R 2013) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959	(2013) Compressible-Washer-Type Direct

	Tension Indicators for Use with Structural Fasteners

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
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 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-01 Preconstruction Submittals

Erection Drawings; G

SD-02 Shop Drawings

Fabrication drawings including description of connections; G

SD-03 Product Data

Shop primer; G

Welding electrodes and rods; G

Non-Shrink Grout; G

Tension control bolts; G

SD-06 Test Reports

Bolts, nuts, and washers

Weld Inspection Reports

Bolt Testing Reports

SD-07 Certificates

Steel

Bolts, nuts, and washers

AISC Fabrication Plant Quality Certification; G

Welding procedures and qualifications; G

Welding electrodes and rods; G

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. Shoring and temporary bracing must be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. 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, including shop primer, 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 C.

2.2.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class As indicated in drawings.

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 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 Direct Tension Indicator Washers

ASTM F959.

2.3.2.4 Washers

ASTM F436, plain carbon steel.

2.3.3 Tension Control Bolts

ASTM F1852, Type 1, heavy-hex or 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 plain or 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.

2.4.3 Welded Shear Stud Connectors

ASTM A29/A29M, Type B. AWS D1.1/D1.1M.

2.5 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.

2.5.1 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.

2.5.2 Shop Primer

Provide SSPC Paint 20 or SSPC Paint 29, (zinc rich primer)except as noted below. Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive sprayed-on fireproofing, surfaces to receive epoxy coatings, surfaces designed as part of a composite steel concrete section, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). 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.

2.5.2.1 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.

2.5.3 Fireproofing and Epoxy Coated Surfaces

Surfaces to receive coatingsmust be cleaned and prepared in accordance with the manufacturer's recommendations, and as specified in Section 07 81 00 SPRAY-APPLIED FIREPROOFING.

2.6 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. 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

Remove only from finished areas.

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 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 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	All field full penetration welds at crippled beams and moment connections
Magnetic Particle	Fillet Welds at 10 locations as selected by the contracting officer
Dye Penetrant	All full penetration welds at butt joints

3.7.2 High-Strength Bolts

3.7.2.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.

3.7.2.2 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.

3.7.2.3 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	(2009) Specification for Welding Procedure and Performance Qualification
AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel

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 TD 10	(2003) Technical Digest No. 10 - Design of Fire Resistive Assemblies with Steel Joists
SJI TD 8	(2008) Technical Digest No. 8 - Welding Of Open-Web Steel Joists And Joist Girders; 2nd Edition
SJI TD 9	(2008) Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; 3rd Edition

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS 14.01	(1982; E 2004) Steel Joist Shop Painting System
SSPC Paint 15	(1999; E 2004) Steel Joist Shop Primer

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

29 CFR 1910.1200	Hazard Communication
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.757	Steel Erection; Open Web Steel Joists

1.2 SUBMITTALS

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-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 TD 8
SJI TD 9
SJI TD 10
29 CFR 1926
29 CFR 1926.757

PART 2 PRODUCTS

2.1 JOISTS, JOIST GIRDERS, AND ACCESSORIES

Provide design data from SJI 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 and SSPC PS 14.01, Steel Joist Shop Painting System, using only Type I, "Red Oxide Paint." Finish coat of paint is specified in Section 09 90 00 PAINTING AND COATING.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Handling and Erection

Conform to SJI 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 grout must be as specified in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE.

3.3 PAINTING

3.3.1 Touch-Up Painting

After erection of joists and joist girders, touch-up connections and areas of abraded shop coat with paint of the same type used for the shop coat.

3.3.2 Field Painting

Paint joists and joist girders requiring a finish coat in conformance with the requirements of Section 09 90 00 PAINTING AND COATING.

3.4 VISUAL INSPECTIONS

3.4.1 Erection Inspection

AWS D1.1/D1.1M, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors. Welding inspectors must visually inspect and mark welds.

-- End of Section --

SECTION 05 30 00

STEEL DECKS
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 APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
FM DS 1-28	(2002) Design Wind Loads

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	(2002; E 2004) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)

STEEL DECK INSTITUTE (SDI)

SDI 31	(2007) Design Manual for Composite Decks, Form Decks, and Roof Decks
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
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 information only. When used, a designation following the "G" designation identifies the office

that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Cant Strips

Ridge and Valley Plates

Metal Closure Strips

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Joint Sealant Material

Mechanical Fasteners

Powder-Actuated Tool Operator

Repair Paint

Welder Qualifications

Welding Equipment

Welding Rods and Accessories

SD-04 Samples

Metal Roof Deck Units

Flexible Closure Strips

Accessories

SD-05 Design Data

Deck Units

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

SD-07 Certificates

. Welding Procedures

Fire Safety

Wind Storm Resistance

1.3 QUALITY ASSURANCE

1.3.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide 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 Fire Safety

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Bld Mat Dir, or listing as Class I construction in the FM APP GUIDE, and so labeled.

1.3.4.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding an uplift pressure of 60 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 inch 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.

2.2.4 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.5 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

2.2.6 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.7 Hanger

Provide clips or loops for utility systems and suspended ceilings of one or more of the following types:

a. Lip tabs or integral tabs where noncellular decking or flat plate of cellular section is 0.0474 inch thick or more, and a structural concrete fill is used over deck.

b. Slots or holes punched in decking for installation of pigtails.

c. Tabs driven from top side of decking and arranged so as not to pierce electrical cells.

d. Decking manufacturer's standard as approved by the Contracting Officer.

2.2.8 Mechanical Fasteners

Provide mechanical fasteners, such as powder actuated or pneumatically driven fasteners, for anchoring the deck to structural supports and adjoining units that are designed to meet the loads indicated. Provide positive locking-type fasteners listed by the Steel Deck Institute and ICC-ES, as approved by the Contracting Officer.

2.2.9 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 0.0474 inch welding washers, 0.0598 inch cant strip, 0.0295 inch other metal accessories, 0.0358 inch unless otherwise indicated. Accessories must include but not be limited to saddles, welding washers, fasteners, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

2.3 FABRICATION

2.3.1 Deck Units

2.3.2 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 galvanized .

2.3.2.1 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 0.0359 inch thick before galvanizing. Provide plates of minimum 4-1/2 inch wide and bent to provide tight fitting closures at ridges and valleys. Provide a minimum length of ridge and valley plates of 10 feet.

2.3.2.2 Metal Closure Stripsfor 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.

2.3.3 Touch-Up Paint

Provide touch-up paint for shop-painted units , and touch-up paint for zinc-coated units of . Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A780/A780M. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the metal floor decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint. Touch up the painted surfaces with paint for the repair of painted surfaces.

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with SDI 31 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. Prepare Neatly fit

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal5/8 inch diameter puddle welds or fastened with screws, powder-actuated fasteners, or pneumatically driven fasteners as indicated on the design drawings and in accordance with manufacturer's recommended procedure and SDI 31. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding or fastening. 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 deck ends. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDMO3. Attach . 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. Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation.

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

Provide as indicated to support utility system and suspended ceilings. Space devices so as to provide one device per 6.25 square feet.

3.3 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inch. For valley plates, provide endlaps to be in the direction of water flow.

3.4 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.

3.5 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.

3.6 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

-- End of Section --

SECTION 05 40 00

COLD-FORMED METAL FRAMING
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 IRON AND STEEL INSTITUTE (AISI)

AISI S200	(2007) North American Standard for Cold-Formed Steel Framing - General Provision
AISI S202	(2011) Code of Standard Practice for Cold-formed Steel Structural Framing
AISI SG02-KIT	(2001; Supp 1 2004) 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 WELDING SOCIETY (AWS)

AWS D1.3/D1.3M	(2008; Errata 2008) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1003/A1003M	(2013b) Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
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 A370	(2014) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM C1007	(2011a) Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM C1513	(2013) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM C955	(2011c) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM E329	(2014a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM F1941	(2010) Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))
ASTM F1941M	(2007) Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Metric)

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

Framing Components; G

a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

SD-03 Product Data

Steel studs,joists, tracks, bracing, bridging and accessories

SD-07 Certificates

Load-bearing cold-formed metal framing

Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A370.

Welds

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3/D1.3M.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to job site and store in adequately ventilated, dry locations. Storage area shall permit easy access for inspection and handling. If necessary to store materials outside, stack off the ground, support on a level platform, and protect from the weather as approved. Handle materials to prevent damage. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust. Replace damaged items with new, as directed by the Contracting Officer. Steel framing and related accessories shall be stored and handled in accordance with the AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".

1.4 LOAD-BEARING COLD-FORMED METAL FRAMING

Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI SG03-3.

1.5 MAXIMUM DEFLECTION

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit framing components to show sizes, thicknesses, layout, material designations, methods of installation, and accessories.

PART 2 PRODUCTS

2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES

Framing components shall comply with ASTM C955 and the following.

2.1.1 Studs and Joists of 16 Gage (0.0538 Inch) and Heavier

Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS Grade 50, G60

2.1.2 Studs and Joists of 18 Gage (0.0478 Inch) and Lighter

Studs and Joists of 18 Gage (0.0428 Inch) and Lighter, Track, and Accessories (All Gages): Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS, Grade 50 33,000 psi G60.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:

a. An ICC number.

b. Manufacturer's identification.

c. Minimum delivered uncoated steel thickness.

d. Protective coating designator.

e. Minimum yield strength.

2.3 CONNECTIONS

Screws for steel-to-steel connections shall be self-drilling, tapping screws in compliance with ASTM C1513 of the type, size and location as shown on the drawings. Electroplated screws shall have a minimum 5 micron zinc coating in accordance with ASTM F1941. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M as appropriate. Screws bolts, and anchors shall be hot dipped galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M as appropriate.

2.4 PLASTIC GROMMETS

Supply plastic grommets, recommended by stud manufacturer, to protect electrical wires. Prevent metal to metal contact for plumbing pipes.

PART 3 EXECUTION

3.1 FASTENING

Fasten framing members together by welding or by using self-drilling or self-tapping screws. Electrodes and screw connections shall be as required and indicated in the design calculations.

3.1.1 Welds

All welding shall be performed in accordance with AWS D1.3/D1.3M, as modified by AISI SG02-KIT. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3/D1.3M. All welds shall be cleaned and coated with rust inhibitive galvanizing paint. Do not field weld materials lighter than 18 gage.

3.1.2 Screws

Screws shall be self-drilling self-tappingtype, size, and location shown on the drawings. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI SG02-KIT. Screws covered by sheathing materials shall have low profile heads.

3.1.3 Anchors

Anchors shall be of the type, size, and location shown on the drawings.

3.1.4 Powder-Actuated Fasteners

Powder-actuated fasteners shall be of the type, size, and location shown on the drawings.

3.2 INSTALLATION

Install cold-formed framing in accordance with ASTM C1007 and AISI S200.

Install cold-formed steel framing according to AISI S202 and to manufacturer's written instructions unless more stringent requirements are indicated.

3.2.1 Tracks

Provide accurately aligned runners at top and bottom of partitions. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 3 inches from the edge of concrete slabs.

3.2.2 Studs

Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and AISI SG03-3, consisting of, as a minimum, runner channel cut to fit between and welded to the studs or hot- or cold-rolled steel channels inserted through cutouts in web of each stud and secured to studs with welded clip angles. Bracing shall be not less than the following:

LOAD	HEIGHT	BRACING
Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

-- End of Section --

SECTION 06 10 00

ROUGH CARPENTRY
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 within the text by the basic designation only.

AMERICAN WOOD COUNCIL (AWC)

AWC WFCM	(2012) Wood Frame Construction Manual for One- and Two-Family Dwellings

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA BOOK	(2012) AWPA Book of Standards
AWPA M2	(2011) Standard for Inspection of Treated Wood Products
AWPA M6	(2013) Brands Used on Preservative Treated Materials
AWPA P18	(2014) Nonpressure Preservatives
AWPA P5	(2014) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

FM GLOBAL (FM)

FM 4435	(2013) Roof Perimeter Flashing

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(2013) Standard Grading Rules for Northeastern Lumber

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	(2002) Standard Grading Rules for Southern Pine Lumber

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS56	(1973) Structural Glued Laminated Timber

1.2 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.3 GRADING AND MARKING

1.3.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.

1.3.2 Preservative-Treated Lumber

The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4 SIZES AND SURFACING

Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.5 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

a. Framing lumber and board, 19 percent maximum

1.6 PRESERVATIVE TREATMENT

Treat wood products with waterborne wood preservatives conforming to AWPA P5. Pressure treatment of wood products shall conform to the requirements of AWPA BOOK Use Category System Standards U1 and T1. Pressure-treated wood products shall not contain arsenic, chromium, or other agents classified as carcinogenic, probably carcinogenic, or possibly carcinogenic to humans (compounds in Groups 1, 2A, or 2B) by the International Agency for Research on Cancer (IARC), Lyon, France. Pressure-treated wood products shall not exceed the limits of the U.S. EPA's Toxic Characteristic Leaching Procedure (TCLP), and shall not be classified as hazardous waste.

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use. 0.60 pcf intended for Ammoniacal Copper Quaternary Compound (ACQ)-treated foundations. 0.80 to 1.00 pcf intended for ACQ-treated pilings. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Minimize cutting and avoid breathing sawdust. The following items shall be preservative treated:

1. Furring and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.

2. Nailers, edge strips, crickets, curbs, and cants for roof decks.

1.6.1 New Construction

Use a boron-based preservative conforming to AWPA P18, sodium silicate wood mineralization process, or Ammoniacal Copper Quaternary Compound to treat wood. Use boron-based preservatives for above-ground applications only.

PART 2 PRODUCTS

2.1 MATERIALS
2.1.1 Plastic Lumber2.1.1.1 Nail Withdrawal

2.2 LUMBER

2.2.1 Structural Lumber

2.2.2 Framing Lumber

Framing lumber such as cant strips, bucks, sleepers, nailing strips, and nailers shall be one of the species listed in the table below. Minimum grade of species shall be as listed. [Finger-jointed lumber may be used in the same applications as solid lumber of an equivalent species and grade, provided the finger-jointed lumber meets all the requirements of the certification and the quality control programs of the rules writing agency having jurisdiction and all applicable requirements of DOC/NIST PS56.

Table of Grades for Framing and Board Lumber			
Grading Rules	Species	Framing	Board Lumber

Table of Grades for Framing and Board Lumber			
Grading Rules	Species	Framing	Board Lumber
SPIB 1003 standard grading rules	Southern Pine	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	No. 2 Boards
NELMA Grading Rules standard grading rules			

Table of Grades for Framing and Board Lumber			
Grading Rules	Species	Framing	Board Lumber

2.3 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be hot-dip zinc-coated in accordance with ASTM A153/A153M.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to AWC WFCM and install in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value Engineering, unless otherwise indicated or specified. Select lumber sizes to minimize waste. Fit lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.1.1 Roof Nailing Strips

Provide roof nailing strips for roof decks as indicated and specified herein.

3.2.1.2 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers shall be 6 inches wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM 4435.

3.2.1.3 Crickets, Cants, and Curbs

Provide wood saddles or crickets, cant strips, and wood nailers bolted to tops of concrete or masonry curbs] [and at expansion joints, as indicated, specified, or necessary.

3.2.2 Rough Wood Bucks

Size as indicated. Set wood bucks true and plumb. Anchor bucks to concrete or masonry with steel straps extending into the wall 8 inches minimum. Place anchors near the top and bottom of the buck and space uniformly at 2 foot maximum intervals.

3.2.3 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

-- End of Section --

SECTION 06 41 16.00 10

ARCHITECTURAL CASEWORK
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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2	(1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI AWS	(2009) Architectural Woodwork Standards

ASTM INTERNATIONAL (ASTM)

ASTM F547	(2006; R 2012) Nails for Use with Wood and Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.9	(2010) Cabinet Hardware

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

ANSI/WDMA I.S.1A	(2013) Interior Architectural Wood Flush Doors

1.2 SYSTEM DESCRIPTION

Work in this section includes custom cabinets and vanities as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09 90 00 PAINTS AND COATINGS.

1.3 SUBMITTALS

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

Shop Drawings
Installation

SD-03 Product Data

Wood Materials
Wood Finishes

SD-04 Samples

Plastic Laminates
Cabinet Hardware

SD-07 Certificates

Quality Assurance

1.4 QUALITY ASSURANCE

1.4.1 General Requirements

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the custom grade quality standards as outlined in AWI AWS, Section 400 for Architectural C abinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Submit a quality control statement which illustrates compliance with and understanding of AWI AWS requirements, in general, and the specific AWI AWS requirements provided in this specification. The quality control statement shall also certify a minimum of ten years Contractor's experience in casework fabrication and construction.

1.5 DELIVERY, STORAGE, AND HANDLING

Casework may be delivered knockdown or fully assembled. Deliver all units to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.6 SEQUENCING AND SCHEDULING

Coordinate work with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

a. All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood.

b. Standing or running trim casework components, which are specified to receive a transparent finish, shall be hardwood species to match plywood panels, plain sawn. AWI grade shall be custom. Location, shape, and dimensions shall be as indicated on the drawings.

2.1.2 Panel Products

2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, AWI AWS Grade AA, Red Oak, plain sawn. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

2.2 SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06 61 16 SOLID POLYMER (SOLID SURFACING) FABRICATIONS.

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of ANSI/NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated in Section 09 06 90 COLOR SCHEDULE. Submit two samples of each plastic laminate pattern and color. Samples shall be a minimum of 2 by 3 inches in size. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraph.

2.3.1 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.4 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be Pwood veneer. M atch exposed door and drawer front veneer.

2.5 CABINET HARDWARE

Submit one sample of each cabinet hardware item specified to include hinges, pulls, drawer glides, and shelf supports. All hardware shall conform to ANSI/BHMA A156.9, unless otherwise noted, and shall consist of the following components:

2.5.1 Door Hinges

Concealed, "Euro-style", 120 deg opening angle, adjustable, self-closing, nickel-plated finish..

2.5.2 Cabinet Pulls

Round knob, "flattened spere" shape, solid brass with ball-bearing.

2.5.3 Drawer Slide

Side mounted with full extension and a minimum 100 pound load capacity. Slides shall include an integralstop to avoid accidental drawer removal.

2.5.4 Adjustable Shelf Support System

Multiple holes with metal pin supports.

2.6 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F547 where applicable.

2.7 ADHESIVES, CAULKS, AND SEALANTS

2.7.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

2.7.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use Adhesives shall withstand a bond test as described in ANSI/WDMA I.S.1A.

2.7.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be an adhesive consistent with AWI and laminate manufacturer's recommendations. PVC edgebanding shall be adhered using a polymer-based hot melt glue.

2.7.2 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

2.8 WOOD FINISHES

Clear finishes and their applications required for wood casework components shall be as indicated in Section 09 90 00 PAINTS AND COATINGS and as indicated in Section 09 06 90 COLOR SCHEDULE..

2.9 FABRICATION

Verify field measurements as indicated in the shop drawings before fabrication. Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI custom grade unless otherwise indicated in this specification. Cabinet style, in accordance with AWI AWS, Section 400-G descriptions, shall be flush inset without face frame.

2.9.1 Base and Wall Cabinet Case Body

2.9.1.1 Cabinet Components

Frame members shall be fastened andglued-together hardwood plywood. Top corners, bottom corners, and cabinet bottoms shall be braced with either plywood hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

2.9.1.1.1 Body Members (Ends, Divisions, Bottoms, and Tops)

3/4 inch veneer core plywood panel product

2.9.1.1.2 Face Frames and Rails

3/4 inch veneer core plywood panel products.

2.9.1.1.3 Shelving

3/4 inch veneer core plywood panel product

2.9.1.1.4 Cabinet Backs

1/4 inch veneer core plywood panel product

2.9.1.1.5 Drawer Sides, Backs, and Subfronts

1/2 inch veneer core plywood panel product

2.9.1.1.6 Drawer Bottoms

1/4 inch veneer core plywood panel product

2.9.1.1.7 Door and Drawer Fronts

3/4-inch veneer core plywood panel product

2.9.1.2 Joinery Method for Case Body Members

2.9.1.2.1 Tops, Exposed Ends, and Bottoms

a. Steel "European" assembly screws (1-1/2 inch from end, 5 inch on center, fasteners will not be visible on exposed parts).

b. Doweled, glued under pressure (approx. 4 dowels per 12 inches of joint).

c. Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

d. Spline or biscuit, glued under pressure.

2.9.1.2.2 Exposed End Corner and Face Frame Attachment

a. Mitired Joint: lock miter or spline or biscuit, glued under pressure (no visible faseners).

b. Non-Mitered Joint (80 degree): butt joint glued under pressure (no visible fasteners).

c. Butt Joint: lued and nailed.

2.9.1.2.3 Cabinet Backs (Wall Hung Cabinets)

Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

a. Full Dound: Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.

b. Full Overlay: Full overlay, plant-on backs with minimum back thickness of 1/2 inchand minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

c. Side Bound: Side bound, captured in grove or rabbetts; glued and fastened.

2.9.1.2.4 Cabinet Backs (Floor Standing Cabinets)

a. Side bound, captured in grooves

b. Full Overlay: Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

c. Side Bound with Rabbetts: Slide bound, placed in rabbetts; glued and fastened in rabbetts.

2.9.1.2.5 Wall Anchor Strips

Wall Anchor Strips shall be required for all cabinets with backs less than 1/2 inch thick. Strips shall consist of minimum 1/2 inch thick lumber or veneer core plywood, minimum 2-1/2 inches width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.9.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of 3/4 inch veneer core exterior plywood. Base assembly components shall be a moisture-resistant panel product. Finished height for each cabinet base shall be as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall [be flush with top of base.

2.9.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 3/4 inch Red Oak Veneer Core Plywood. All door and drawer front edges shall be surfaced with matching veneer edgebanding.

2.9.4 Drawer Assembly

2.9.4.1 Drawer Components

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

2.9.4.1.1 Drawer Sides and Backs For Transparent Finish

1/2 inch thick 7-ply hardwood veneer core plywood (no voids), any species

2.9.4.1.2 Drawer Bottom

1/4 inch thick veneer core panel product for transparent finish.

2.9.4.2 Drawer Assembly Joinery Method

a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.

b. Doweled, glued under pressure.

c. Lock shoulder, glued and pin nailed.

d. Bottoms shall be set into sides, front, and back, 1/4 inch deep groove with a minimum 3/8 inch standing shoulder.

2.9.5 Shelving

2.9.5.1 General Requirements

Shelving shall be fabricated from 3/4 inch veneer core plywood. Shelf edges shall be finished in a edgebanding.

2.9.5.2 Shelf Support System

The shelf support system shall be:

a. Pin Hole Method: rill holes on the interior surface of the cabinet side walls. Evenly space holes in two vertical columns Space the holes in each column at 1 inch increments starting 6 inches from the cabinet interior bottom and extending to within 6 inches of the top interior surface of the cabinet. Drill holes to provide a level, stable surface when the shelf is resting on the shelf pins. Coordinate hole diameter with pin insert size to provide a firm, tight fit.2.9.6 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and ANSI/NEMA LD 3, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish.

Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

2.9.6.1 Vanity Cabinet Case Body

a. Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS.

2.9.6.2 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI AWS custom grade requirements.

2.9.7 Finishing

2.9.7.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

2.9.7.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

2.9.7.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule, drawings and Section 09 90 00 PAINTS AND COATINGS. All cabinet reveals shall be painted. Submit descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI AWS for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI AWS custom quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be

attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system as required . Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Where assembly abuts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Cabinet and vanities to be wall mounted shall utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings.

3.1.3 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI AWS custom grade requirements.

3.1.4 Plumbing Fixtures

Install sinks, sink hardware, and other plumbing fixtures in locations as indicated on the drawings and in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.1.5 Glass

Install glass and glazing in the casework using methods and materials specified in Section 08 81 00 GLAZING in locations as indicated on the drawings.

-- End of Section --

SECTION 06 61 16

SOLID POLYMER (SOLID SURFACING) FABRICATIONS
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 D2583	(2013a) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D638	(2010) Standard Test Method for Tensile Properties of Plastics
ASTM D696	(2008; E 2013) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM G21	(2013) Determining Resistance of Synthetic Polymeric Materials to Fungi

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO Z124.3	(2005) Plastic Lavatories
IAPMO Z124.6	(2007) Plastic Sinks

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3	(2005) Standard for High-Pressure Decorative Laminates

NSF INTERNATIONAL (NSF)

NSF/ANSI 51	(2012) Food Equipment Materials

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA Hdbk	(2013) Handbook for Ceramic, Glass, and Stone Tile Installation

1.2 SYSTEM DESCRIPTION

a. Work under this section includes countertops and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected.

b. In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to ensure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of wall panels, countertops, shelving, and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer.

c. Appropriate staging areas for solid polymer fabrications. Allow variation in component size and location of openings of plus or minus 1/8 inch.

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
Installation; G

SD-03 Product Data

Solid polymer material
Qualifications
Fabrications
Certification
VOC Content

SD-04 Samples

Material; G

SD-06 Test Reports

Solid polymer material

SD-07 Certificates

Fabrications
Qualifications

SD-10 Operation and Maintenance Data

Clean-up

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

To ensure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. Mark all fabrications with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials. Submit solid polymer manufacturer's certification attesting to fabricator qualification approval.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver materials to project site until areas are ready for installation. Deliver components and materials to the site undamaged, in containers clearly marked and labeled with manufacturer's name. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation, for duration of project.

1.6 WARRANTY

Provide manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

PART 2 PRODUCTS

2.1 MATERIAL

Provide solid polymer material that is a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting IAPMO Z124.3 and IAPMO Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than 1/4 inch in thickness. Submit a minimum 4 by 4 inch sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work. Submit test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.

2.1.1 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4000 psi (max.)	ASTM D638
Hardness	55-Barcol Impressor (min.)	ASTM D2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D696
Boiling Water Surface Resistance	No Change	ANSI/NEMA LD 3-3.05
High Temperature Resistance	No Change	ANSI/NEMA LD 3-3.06
Impact Resistance (Ball drop)		ANSI/NEMA LD 3-303
1/4 inch sheet	36 inches, 1/2 lb ball, no failure	
1/2 inch sheet	140 inches, 1/2 lb ball, no failure	
3/4 inch sheet	200 inches, 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G21
Bacteria Growth	No growth	ASTM G21
Liquid Absorption (Weight in 24 hrs.)	0.1 percent max.	ASTM D570
Flammability		ASTM E84
Flame Spread	25 max.	
Smoke Developed	30 max.	
Sanitation	"Food Contact" approval	NSF/ANSI 51

2.1.2 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project color schedule. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

2.1.3 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be matte; gloss rating of 5-20

2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid

polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting TCNA Hdbk, Underwriter's Laboratories (UL) listed. Use this adhesive to bond solid polymer components to adjacent and underlying substrates.

2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and OSHA Nationally Recognized Testing Laboratory (NRTL) listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Use sealant to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

2.2.4 Mounting Hardware

Provide mounting hardware, including sink/bowl clips, inserts and fasteners for attachment of undermount sinks and lavatories.

2.3 FABRICATIONS

Components shall be factory or shop fabricated to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Provide factory cutouts for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected. Submit product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, and sealants. Both the manufacturer of materials and the fabricator shall submit a detailed description of operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

2.3.1 Joints and Seams

Form joints and seams between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter and Vanity Top Splashes

Fabricate backsplashes and end splashes from solid surfacing material to be in conformance with dimensions and shapes as indicated on the drawings. Backsplashes and end splashes shall be provided for all counter tops and vanity tops at locations indicated on the drawings. Backsplashes shall be shop fabricated and be loose, to be field attached.

2.3.3.1 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Counter and Vanity Tops

Fabricate all solid surfacing, solid polymer counter top and vanity top components from 1/2 inch thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Attach 2 inch wide reinforcing strip of polymer material under each horizontal counter top seam. Solid polymer material shall be of a pattern and color as indicated on the drawings. S

2.3.4.1 Counter Top With Sink

a. Stainless Steel or Vitreous China Sink. Countertops with sinks shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 22 00 00 PLUMBING,GENERAL PURPOSE.

2.3.4.2 Vanity Tops With Bowls

a. Countertops with vitreous china bowls shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for vitreous china installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 22 00 00 PLUMBING,GENERAL PURPOSE.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Components

Install all components and fabricated units plumb, level, and rigid. Make field joints between solid polymer components using solid polymer manufacturer's approved seam adhesives, to provide a monolithic appearance

with joints inconspicuous in the finished work. Attach metal or vitreous china sinks and lavatory bowls to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Plumbing connections to sinks and lavatories shall be made in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.1.1.1 Loose Counter Top Splashes

Mount loose splashes in the locations noted on the drawings. Loose splashes shall be adhered to the counter top with a color matched silicone sealant when the solid polymer components are solid colors. Use a clear silicone sealant to provide adhesion of particulate patterned solid polymer splashes to counter tops.

3.1.2 Silicone Sealant

Use a clear, silicone sealant or caulk to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

3.1.3 Plumbing

Make plumbing connections to sinks and lavatories in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items.

-- End of Section --

SECTION 07 11 13

BITUMINOUS DAMPPROOFING
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 D1227	(2013) Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D226/D226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D4263	(1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method

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-07 Certificates

Materials

1.3 DELIVERY AND STORAGE

Deliver materials in sealed containers bearing manufacturer's original labels. Labels shall include date of manufacture, contents of each container, performance standards that apply to the contents and recommended shelf life.

PART 2 PRODUCTS

2.1 ASPHALT PRIMER (If Required)

ASTM D4479/D4479M, Type 1, 25 recommended by manufacturer.

2.2 EMULSION-BASED ASPHALT DAMPPROOFING

2.2.1 Fibrated Emulsion-Based Asphalt

Fibrated emulsion-based asphalt dampproofing shall be cold-applied type conforming to ASTM D1227 Type II, Class 1, asbestos-free, manufactured of refined asphalt, emulsifiers and selected clay, fibrated with mineral fibers. For spray or brush application, emulsion shall contain a minimum of 59 percent solids by weight, 56 percent solids by volume. For trowel

application, emulsion shall contain a minimum of 58 percent solids by weight, 55 percent solids by volume.

2.3 SURFACE PROTECTION (AS NEEDED)

2.3.1 Saturated Felt

ASTM D226/D226M, Asphalt Saturated, Type I, 15 pound.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean masonry surfaces to receive dampproofing of foreign matter and loose particles. Apply dampproofing to clean dry surfaces. Moisture test in accordance with ASTM D4263. If test indicates moisture, allow a minimum of 7 additional days after test completion for curing. If moisture still exists, redo test until substrate is dry.

3.2 Protection of Surrounding Areas

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of dampproofing material onto other work.

3.3 APPLICATION

3.3.1 Cold-Application Method

3.3.1.1 Emulsion-Based Asphalt

Emulsion-based asphalt dampproofing work shall not be performed in temperatures below 40 degrees F. Emulsions shall have a smooth and uniform consistency at time of application. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film of not less than 12 mils thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

a. Primer (If Required): 1/2 gallon per 100 square feet, cold-applied.

b. Fibrated Dampproofing: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.

3.4 PROTECTIVE COVERING

Protect dampproofed surfaces against which backfill will be placed with one layer of 15 pound saturated felt conforming to the requirements specified herein.

-- End of Section --

SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION
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.

ASTM INTERNATIONAL (ASTM)

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
ASTM D3575	(2014) Flexible Cellular Materials Made From Olefin Polymers
ASTM D3833/D3833M	(1996; R 2011) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM E136	(2012) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

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

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

Blanket insulation

Accessories

SD-08 Manufacturer's Instructions

Insulation

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

ASTM C665, Type II, blankets with non-reflecting coverings; Class A, membrane-faced surface with a flame spread of 25 or less when tested in accordance with ASTM E84.

2.1.1 Thermal Resistance Value (R-VALUE)

As indicated

2.1.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:

Rock Wool: 75 percent slag
Fiberglass: 20 to 25 percent glass cullet

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.2 [SILL SEALER INSULATION

Provide polyethylene foam sill sealer [3.5] [5.5] [7.5] [9.5] inches in width with the following characteristics:.

Physical Properties	Test Method	Measurement
Nominal Thickness	ASTM D3575	3/16 inch
Compressive Strength	ASTM D3575	1.2 psi
- Vertical Direction	Suffix D	
Tensile Strength	ASTM D3575	32 psi
	Suffix T	

]2.3 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E136 for blocking around chimneys and heat producing devices.

2.4 PRESSURE SENSITIVE TAPE

As recommended by the vapor retarder manufacturer and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D3833/D3833M.

2.5 ACCESSORIES

2.5.1 Adhesive

As recommended by the insulation manufacturer.

2.5.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.5.3 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Contracting Officer of such conditions.

3.2 INSTALLATION

3.2.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.2.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.2.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.2.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.2.1.4 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

-- End of Section --

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 C1289	(2014) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal 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/

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-02 Shop Drawings

Show a complete description of the procedures for the installation of each phase of the system indicating the type of materials, thicknesses, special methods for cutting and fitting of insulation, and special precautions. The drawings shall be based on field measurements.

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

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 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 onSteel 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; and

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. 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 of the following material and compatible with attachment methods for the specified insulation and metal roof panels:

a. Polyisocyanurate Board: ASTM C1289 Type II, fibrous felt or glass mat membrane both sides, except minimum compressive strength shall be 20 pounds per square inch (psi).

2.1.2 Insulation Thickness

As necessary to provide a thermal resistance (R value) of 30. Thickness shall be based on the "R" value for aged insulation. Insulation over steel decks shall satisfy both specified R value and minimum thickness for width of rib opening recommended in insulation manufacturer's published literature.

2.2 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 120 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 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.

3.2 INSULATION INSTALLATION

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.

3.2.2 Special Precautions for Installation of Foam Insulation

3.2.2.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 1/2 inch thick wood fiberboard, glass mat gypsum roof board, or 3/4 inch thick expanded perlite board insulation over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Protect open spaces between insulation and parapets or other walls until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking 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 proper storage and handling of insulation materials before, during, and after installation.

c. Inspection of mechanical fasteners; type, number, length, and spacing.

d. Coordination with other materials.

e. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

-- End of Section --

SECTION 07 42 13

INSULATEDMETAL WALL 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.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2005) Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure

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

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 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 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 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 E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

ASTM E72	(2014a) Conducting Strength Tests of Panels for Building Construction
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

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA MBSM	(2002) Metal Building Systems Manual

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

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

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

1.2 DEFINITIONS

Insulated Metal Wall Panel: Insulated metal wall panels, attachment system components and accessories necessary for a complete weather-tight wall system.

1.3 DESCRIPTION OF INSULATED WALL PANEL SYSTEM

Factory color finished, galvalume metal wall panel system with concealed fasteningattachment. Panel profile must be embossed and with stiffening ribs on the interior face of the panel.

1.3.1 Insulated Metal Wall Panel General Performance

Comply with performance requirements, conforming to AISI S100, without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1.3.2 Structural Performance

Maximum calculated fiber stress must not exceed the allowable value in the AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads is limited to L/180. Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Contractor must provide design for members and connections not shown on the drawings. Siding panels and accessories must be the products of the same manufacturer.

Provide insulated metal wall panel assemblies complying with the load and

stress requirements in accordance with ASTM E1592. Wind Load force due to wind action governs the design for panels.

Wall systems and attachments are to resist the wind loads as determined by ASTM E72 and ASCE 7 in the geographic area where the construction will take place, in pounds per square foot.

1.3.3 Air Infiltration

Air leakage must conform to the limits through the wall assembly area when tested according to ASTM E283.

1.3.4 Water Penetration Under Static Pressure

No water penetration when tested according to ASTM E331.

1.3.5 Water Penetration Under Dynamic Pressure

No evidence of water leakage when tested according to AAMA 501.1.

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 Documentation for the following items:

Qualification of Manufacturer; G
Qualification of Installation Contractor; G

Sample Warranty; G

SD-02 Shop Drawings

Installation Drawings ; G

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Insulated Wall Panels ; G

Factory Color Finish
Closure Materials

Sealants and Caulking

Enamel Repair Paint

Accessories

SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width; G
Fasteners; G
Metal Closure Strips, 10 inches long of each type; G

Color chart and chips; G

Submit manufacturer's color charts and chips, approximately 4 by 4 inches, showing full range of colors, textures and patterns available for wall panels with factory applied finishes.

SD-05 Design Data

Wind load design analysis; G

As applicable, submit the following wind load design analysis data, to include, but not limited to:

wind speed
exposure category,co-efficient,importance factor
type of facility
negative pressures for each zone
methods and requirements of attachment

SD-06 Test Reports

Submit test reports for the following in accordance with the referenced articles in this section.

Leakage Tests; G
Wind Load Tests; G
Coating Tests; G

SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Coil Stock; G
Fasteners; G

SD-08 Manufacturer's Instructions

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications.

Installation of Wall panels; G

SD-11 Closeout Submittals

Warranty; G
Maintenance Instructions; G

1.5 QUALITY ASSURANCE

1.5.1 Pre-Installation Conference

1.5.2 Qualification of Manufacturer

Certify that insulated metal wall panel system manufacturer has a minimum

of five (5) years experience in manufacturing insulated metal wall system and accessory products.

1.5.3 Certified Qualification of Installation Contractor

The installation contractor must be approved and certified by the insulated metal wall panel manufacturer prior to beginning the installation of the insulated metal wall panel system. Subcontracting by Certified Contractor for the insulated metal wall panel work is not permitted.

1.5.4 Single Source

Obtain each type of wall panel, clips, closure materials and other accessories from the standard products of the single source from a single manufacturer to operate as a complete system for the intended use.

1.5.5
Manufacturer's Maintenance Instructions

Provide manufacturer's detailed written instructions including copies of Material Safety Data Sheets for maintenance and repair materials.

1.6 DELIVERY, HANDLING, AND STORAGE

Deliver and protect package components, sheets,insulated metal wall panels, and other manufactured items to prevent damage or deformation during transportation and handling.

Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

Stack and store metal wall panels horizontally on platforms or pallets, covered with suitable weather-tight and ventilated covering to ensure dryness, with positive slope for drainage of water. Do not store insulated metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

Retain strippable protective covering on metal wall panel until actual installation.

1.7 PROJECT CONDITIONS

1.7.1 Field Measurements

Verify locations of wall framing and opening dimensions by field measurements before metal insulated wall panel fabrication and indicate measurements on Shop Drawings.

1.7.2 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into wall system or building.

1.8 WARRANTY

Warranty must conform to the Sample Warranty as reviewed and approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 FABRICATION

Unless approved otherwise, fabricate and finish insulated metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated and specified performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel. Fabricate insulated metal wall panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

2.1.1 Sheet Metal Accessories

Fabricate flashing and trim to comply with recommendations in SMACNA 1793 that apply to the design, dimensions, metal, and other characteristics of item indicated:

a. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

b. End Seams: fabricate nonmoving end seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

c. Sealed Joints: form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA 1793.

d. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

e. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA 1793 or by metal wall panel manufacturer for application, but not less than thickness of metal being secured.

2.2 PANEL MATERIALS

2.2.1 Steel Sheet

Roll-form steel wall panels to the specified profile, with 24 gauge exterior, 26 gauge interior,and depth as indicated. Material must be plumb and true, and within the tolerances listed:

a. Aluminum-Zinc Alloy-coated Steel Sheet conforming to ASTM A792/A792M and AISI SG03-3.

b Individual panels must be continuous length to cover the entire length of any unbroken wall area with no joints or seams and formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

c. Provide panels with thermal expansion and contraction consistent with the type of system specified.

1. Panel width: 36 inches.
2. Panel Thickness: 2-1/2 inches.
3. Insulation material: Non-CFC foamed-in-place polyurethane foam cored to achieve a minimum density fo 2.2 pounds.
4. Exterior Finish: Stucco-Embossed.
5. Interior Finish: Stucco-embossed.

2.2.2 Factory Color Finish

Comply with NAAMM AMP 500 for recommendations for applying and designating finishes. Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

All panels are to receive a factory-applied Kynar 500/Hylar 5000 finish consisting of a baked-on top-coat with a manufacturer's recommended prime coat conforming to the following:

2.2.2.1 Metal Preparation

Carefully prepare all metal surface for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with acid rinse, and thorough drying.

2.2.2.2 Prime Coating

Apply a base coat of epoxy paint, specifically formulated to interact with the top-coat, to the prepared surfaces by roll coating to a dry film thickness of 0.20 plus 0.05 mils. Prime coat must be oven cured prior to application of finish coat.

2.2.2.3 Exterior Finish Coating

Roll coat the finish coating over the primer by roll coating to dry film thickness of 0.80 plus 5 mils (3.80 plus 0.50 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). Oven-cure finish coat.

2.2.2.4 Interior Finish Coating

Apply a wash-coat on the reverse side over the primer by roll coating to a dry film thickness of 0.30 plus 0.05 mils for a total dry film thickness of 0.50 plus 0.10 mils. Oven-cured the wash coat.

2.2.2.5 Color

Provide exterior finish color to match Hangar 450. Provide interior finish color to match the manufacturer's standard white..

2.2.2.6 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

2.3 MISCELLANEOUS METAL FRAMING

Cold-formed metallic-coated steel sheet conforming to ASTM A653/A653M and specified in Section 05 40 00 COLD-FORMED METAL FRAMING unless otherwise indicated.

2.3.1 Fasteners for Miscellaneous Metal Framing

Type, material, corrosion resistance, size and sufficient length to penetrate the supporting member a minimum of 1 inch with other properties required to fasten miscellaneous metal framing members to supporting members and substrates in accordance with the wall panel manufacturer's and ASCE 7 requirements.

2.4 FASTENERS

2.4.1 General

2.4.1.1 Hidden Fasteners

Provide corrosion resistant fasteners recommended by the manufacturer to meet the performance requirements and design loads.

2.5 ACCESSORIES

2.5.1 General

All accessories must be compatible with the insulatedmetal wall panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the wall panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated.

2.5.2 Metal Closure Trim

Provide factory fabricated steel closure strips to be the same gauge, color, finish and profile of the specified wall panel.

2.5.3 Joint Sealants

2.5.3.1 Sealants and Caulking

Provide approved gun type sealants for use in-hand- or air-pressure caulking guns at temperatures above 4 degrees C (or frost-free application at temperatures above 10 degrees F with minimum solid content of 85 percent of the total volume. Sealants must dry with a tough, durable surface skin which permit remaining soft and pliable underneath, providing a weather-tight joint.

Prime all joints receiving sealants with a compatible one-component or two-component primer as recommended by the wall panel manufacturer.

2.6 SHEET METAL FLASHING AND TRIM

2.6.1 Fabrication

Shop fabricate sheet metal flashing and trim where practicable to comply with recommendations in SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

2.7 REPAIR OF FINISH PROTECTION

Repair paint for color finish wall panel must be compatible paint of the same formula and color as the specified finish furnished by the wall panel manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, insulated metal wall panel supports, and other conditions affecting performance of the Work.

Examine primary and secondary wall framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by insulated metal wall panel manufacturer, UL, ASTM, ASCE 7 and as required for the geographical area where construction will take place.

Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by insulated metal wall panel manufacturer.

Examine roughing-in for components and systems penetrating insulated metal wall panels to verify actual locations of penetrations relative to seam locations of wall panels before wall panel installation.

Submit to the Contracting Officer a written report, endorsed by Installer, listing conditions detrimental to performance of the Work. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Miscellaneous framing installation, including sub-purlins, girts, angles, furring, and other miscellaneous wall panel support members and anchorage must be according to insulated metal wall panel manufacturer's written instructions.

3.3 WALL PANEL INSTALLATION

Provide full length insulated metal wall panels, from sill to eave as indicated, unless otherwise indicated or restricted by shipping limitations. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement in accordance with MBMA MBSM.

Erect wall panel system in accordance with the approved erection drawings, the printed instructions and safety precautions of the manufacturer.

Sheets are not to be subjected to overloading, abuse, or undue impact. Bent, chipped, or defective sheets shall not be applied.

Sheets must be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated eave, and sill.

Work is to allow for thermal movement of the wall panel, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Field cutting insulated metal wall panels by torch is not permitted.

3.3.1 Steel Wall Panels

Use stainless-steel fasteners for exterior and interior surfaces.

3.3.2 Anchor Clips

Anchor metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.3.3 Metal Protection

Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

3.3.4 Joint Sealers

Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of insulated metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by insulated metal wall panel manufacturer.

3.4 FASTENER INSTALLATION

Anchor insulated metal wall panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

3.5 FLASHING, TRIM AND CLOSURE INSTALLATION

3.5.1 General Requirements

Comply with performance requirements, manufacturer's written installation instructions, and SMACNA 1793. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams to form permanently watertight and weather resistant.

Install sheet metal work is to form weather-tight construction without waves, warps, buckles, fastening stresses or distortion, and allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades is to be performed by sheet metal mechanics.

3.5.2 Metal Flashing

Install exposed metal flashing at building corners, sills and eaves, junctions between metal siding and walling. Exposed metal flashing must be the same material, color, and finish as the specified insulated metal wall panel.

Fasten flashing at a minimum of 8 inches on center, except where flashing is held in place by the same screws that secure covering sheets.

Flashing is to be furnished in at least 8 foot lengths. Exposed flashing is to have 1 inch locked and blind-soldered end joints, and expansion

joints at intervals of not more than 16 feet.

Exposed flashing and flashing subject to rain penetration to be bedded in the specified joint sealant.

Isolate flashing which is in contact with dissimilar metals by means of the specified asphalt mastic material to prevent electrolytic deterioration.

Form drips to the profile indicated, with the edge folded back 1/2 inch to form a reinforced drip edge.

3.6 WORKMANSHIP

Make lines, arises, and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793.

3.7 ACCEPTANCE PROVISIONS

3.7.1 Erection Tolerances

Erect insulated metal wall panels straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions.

3.7.2 Leakage Tests

Inspection and testing is to be made promptly after erection to permit correction of defects and the removal and replacement of defective materials.

3.7.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials. Finished repaired surfaces must be uniform and free from variations of color and surface texture.

Repaired metal surfaces that are not acceptable to the project requirements and/or Contracting Officer are to be immediately removed and replaced with new material.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

Make visual inspections as necessary to ensure compliance with specified requirements. Additionally, verify the following:

a. Materials comply with the specified requirements.

b. All materials are properly stored, handled and protected from damage.

Damaged materials are removed from the site.

c. Framing and substrates are in acceptable condition, in compliance with specification, prior to application of wall panels.

d. Panels are installed without buckles, ripples, or waves and in uniform alignment and modulus.

e. The proper number, type, and spacing of attachment clips and fasteners are installed.

f. Installer adheres to specified and detailed application parameters.

g. Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

3.9 CLEAN-UP AND DISPOSAL

Clean all exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from work area. Remove grease and oil films, excess sealants, handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces must be free of dents, creases, waves, scratch marks, solder or weld marks, and damage to the finish coating.

Collect and place scrap/waste materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site; transport demolished materials from government property and legally dispose of them.

-- End of Section --

SECTION 07 52 00

MODIFIED BITUMINOUS MEMBRANE ROOFING
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.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2010; ERTA 2011-2014; Thru INT 24 2015) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.24	(2014) Roofing - Safety Requirements of Low-Sloped Roofs

ASPHALT ROOFING MANUFACTURER'S ASSOCIATION (ARMA)

ARMA 410BUR88	(2001) Manual of Roof Maintenance and Repair
ARMA PMBRG98	(1998) Quality Control Guideline for the Application of Polymer Modified Bitumen Roofing

ASTM INTERNATIONAL (ASTM)

ASTM C1153	(2010) Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging
ASTM C1289	(2014a) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C208	(2012) Cellulosic Fiber Insulating Board
ASTM C552	(2014) Standard Specification for Cellular Glass Thermal Insulation
ASTM C578	(2014a) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

ASTM C726	(2012) Mineral Fiber Roof Insulation Board
ASTM C728	(2013) Perlite Thermal Insulation Board
ASTM D1668/D1668M	(1997a; R 2014; E 2014) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D1863/D1863M	(2005; R 2011; E 2012) Mineral Aggregate Used on Built-Up Roofs
ASTM D1970/D1970M	(2015) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D2170/D2170M	(2010) Kinematic Viscosity of Asphalts (Bitumens)
ASTM D2824/D2824M	(2013) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos
ASTM D312/D312M	(2015) Standard Specification for Asphalt Used in Roofing
ASTM D4073	(2006; R 2013) Standard Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes
ASTM D41/D41M	(2011) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D4263	(1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4402/D4402M	(2015) Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D4586/D4586M	(2007; E 2012; R 2012) Asphalt Roof Cement, Asbestos-Free
ASTM D4601/D4601M	(2004; R 2012) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D4637/D4637M	(2014; E 2014) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D4897/D4897M	(2001; R 2009) Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM D5147/D5147M	(2014) Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
ASTM D6162/D6162M	(2000a; R 2015; E 2015) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet

	Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D6163/D6163M	(2000; R 2015; E 2015) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
ASTM D6164/D6164M	(2011) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM D6222/D6222M	(2011) Atactic Polypropylene (ARP) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM D6223/D6223M	(2002; E 2009; R 2009) Standard Specification for Atactic Polypropylene (ARP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D6298	(2013) Fiberglass Reinforced Styrene-Butadiene-Styrene (SBS) Modified Bituminous Sheet with Factory Applied Metal Surface
ASTM E108	(2011) Fire Tests of Roof Coverings

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/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2012) International Building Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z87.1	(2010) Occupational and Educational Personal Eye and Face Protection Devices

MIDWEST ROOFING CONTRACTORS ASSOCIATION (MRCA)

CERTA	(2003) NRCA/MRCA Certified Roofing Torch Applicator Program

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2013) Standard for Safeguarding Construction,Alteration, and Demolition Operations

NFPA 58	(2014; TIA 13-1; TIA 13-2; Errata 13-1; TIA 13-3; Errata 14-2) Liquefied Petroleum Gas Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA C3701	(2002) Repair Manual for Low Slope Membrane Roof Systems
NRCA Details	(2003) NRCA Roof Perimeter Flashing Systems Construction Details for Class 1 Roof Construction
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

SINGLE PLY ROOFING INDUSTRY (SPRI)

ANSI/SPRI/FM 4435/ES-1	(2011) Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

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

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.12	Construction Work
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.16	Rules of Construction

UNDERWRITERS LABORATORIES (UL)

UL 790	(2004; Reprint Jul 2014) Standard Test Methods for Fire Tests of Roof Coverings
UL RMSD	(2012) Roofing Materials and Systems Directory

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEM[S]

[[Minimum [two-ply][three-ply] SBS [or] [APP] [modified bitumen roof membrane consisting of [modified bitumen base sheet][fiberglass felt [venting]base sheet] [,interply sheet] and cap sheet. Modified bitumen roof membrane must be [set in hot asphalt][torch applied]][set in cold-applied adhesive].]

][[_____]: Minimum [two-ply][three-ply] SBS [or] [APP] modified bitumen roof membrane consisting of [modified bitumen base sheet][fiberglass felt [venting] base sheet] [,interply sheet] and cap sheet. Modified bitumen roof membrane must be [set in hot asphalt][torch applied][set in

cold-applied adhesive].

] All work must follow the NRCA RoofMan guidelines and standards stated within this Section.

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.][for information only.][When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roof plan; G[, [_____]] drawing depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, as applicable

SD-03 Product Data

Modified Bitumen Sheets; G[, [_____]]

[Asphalt

][Cold-Applied Membrane Adhesive; G[, [_____]]

][Fiberglass Felt; G[, [_____]]

] Primer; G[, [_____]]

Modified Bitumen Roof Cement; G[, [_____]]

[Pre-Manufactured Accessories

] Fasteners And Plates; G[, [_____]]

Sample Warranty certificate; G[, [_____]]

Submit all data required by Section 07 22 00 ROOF AND DECK INSULATION, together with requirements of this section. Include in data written acceptance by the roof membrane manufacturer of the products and accessories provided. Products must be as listed in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the Contracting Officer.

SD-05 Design Data

Wind Uplift Calculations; G[, [_____]]

[Provide Engineering calculations, signed, sealed, and dated by a qualified Engineer validating the wind resistance per ASCE 7, ASTM D4073, and ANSI/SPRI/FM 4435/ES-1 of non-rated roof system.

] SD-07 Certificates

Provide evidence that products used within this specification are manufactured in the United States.

Qualification of Manufacturer

Certify that the manufacturer of the modified bitumen membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator."

Qualification of Engineer of Record

Certify that the Engineer of Record is fully qualified, competent, and currently licensed to practice in the project jurisdiction.

[Bill of Lading

Submit bill of lading when labels of asphalt containers do not bear the flash point (FP), finished blowing temperature (FBT), and equiviscous temperature (EVT).

] Wind Uplift Resistance; G[, [_____]] classification, as applicable

Fire Resistance classification; G[, [_____]]

Submit the roof system assembly [wind uplift and] fire rating classification listings.

SD-08 Manufacturer's Instructions

Modified Bitumen Membrane Application; G[, [_____]]

Flashing; G[, [_____]]

[Temperature Limitations for Asphalt

][Torches

][Cold Adhesive Applied Modified Bitumen Membrane; G[, [_____]]

][Base Sheet attachment, including pattern and frequency of mechanical attachments required in field of roof, corners, and perimeters to provide for the specified wind resistance.

] Primer

Fasteners

Ventilating Base Sheets

[Coating Application; G[, [_____]]

] Cold Weather Installation; G[, [_____]]

Include detailed application instructions and standard

manufacturer drawings altered as required by these specifications. [Include membrane manufacturer requirements for nailers and backnailing of roof membrane on steep slopes.] Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To [Government][Contractor] Personnel

Include copies of Material Safety Data Sheets for maintenance/repair materials.

Submit 20 year "No-Dollar-Limit" warranty for labor and materials.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Modified bitumen sheet roofing system manufacturer must have a minimum of [5][_____] years experience in manufacturing modified bitumen roofing products.

1.4.2 Qualification of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the modified bitumen sheet roofing system manufacturer and have a minimum of [five][_____] years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator must supply the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.3 Qualifications of Photovoltaics (PV) Rooftop Applicator

The PV rooftop applicator must be approved, authorized, or certified by a Roof Integrated Solar Energy (RISE) Certified Solar Roofing Professional (CSRP), and comply with applicable codes, standards, and regulatory requirements to maintain the weatherproofing abilities of both the integrated roof system and photovoltaic system.

1.4.4 Qualification of Engineer of Record

[Engineer of Record must be currently licensed within the jurisdiction of the project.

][Engineer of Record must be approved, authorized, and currently licensed by the state of [Florida][_____], and have a minimum of five years experience as an approved Engineer for manufacturers of similar roof systems. Engineer of Record must supply the names and locations of five projects of similar size and scope for which he has provided engineering calculations using the manufacturer's products submitted for this project within the previous three years. Engineer of Record must provide certified

engineering calculations for:

] [Wind uplift requirements][in accordance with [Local and State codes]

ASCE 7,in accordance with International Building Code.

[Seismic requirements per [local] [and state] building codes]

[Seismic requirements per ICC IBC Chapter 16, Section 1608.3

][Snow load requirements per ICC IBC Chapter 16 Section 1608.3 and Section 7 of ASCE 7

]]1.4.5 Fire Resistance

Complete roof covering assembly must:

a. Be Class A [or B] rated in accordance with ASTM E108, FM 4470, or UL 790; and

b. Be listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM APP GUIDE.

FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

1.4.6 Wind Uplift Resistance

The complete roof system assembly shall be rated and installed to resist wind loads [indicated] [calculated in accordance with ASCE 7] and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Non-rated systems must not be installed, except as approved by the Contracting Officer. Submit licensed engineer's Wind uplift calculations and substantiating data to validate any non-rated roof system. Base wind uplift measurements on a design wind speed of [_____] mph in accordance with ASCE 7and/or other applicable building code requirements.

1.4.7 Preroofing Conference

After approval of submittals and before performing roofing [and insulation] system installation work, hold a preroofing conference to review the following:

a. Drawings, including Roof Plan, specifications and submittals related to the roof work

[Field inspection and verification of all existing conditions, including all fire safety issues, existing structure, and existing materials, including concealed combustibles, which may require additional protection during installation.

] b. Roof system components installation

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roof structure, and roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing

e. Quality control, (ARMA PMBRG98) plan for the roof system installation

f. Safety requirements

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing [and insulation], flashing and sheet metal work, [[mechanical] [and] [electrical] work], other trades interfacing with the roof work, designated safety personnel trained to enforce and comply with ASSE/SAFE A10.24,[Fire Marshall,] and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification, the container must bear the specification number, type, and class, as applicable. [Labels or bill of lading for roofing asphalt must indicate asphalt type, FP, FBT, and EVT, that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with ASTM D2170/D2170M or 75 centipoise when tested in accordance with ASTM D4402/D4402M.] Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

Maintain a minimum distance of 35 foot for all stored flammable materials, including materials covered with shrink wraps, craft paper and/or tarps from all torch/welding applications.

Immediately remove wet, contaminated or otherwise damaged or unsuitable

materials from the site. Damaged materials may be marked by the Contracting Officer.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 40 degrees F, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

[1.7 [TORCH][HOT-MOPPED ASPHALT] APPLIED [(HEAT WELD)] MODIFIED BITUMEN MEMBRANE SAFETY

1.7.1 Property Protection

Take all precautions necessary to prevent ignition of combustible materials during [torch application][hot-mopped asphalt application] of roofing. Immediately call the fire department if a fire commences. Review all fire safety procedures as outlined at the pre-roofing conference.

Install materials using the techniques recommended by CERTA NRCA/MRCA Certified Roofing Torch Applicator Program available from the National Roofing Contractors Association (NRCA) and the Midwest Roofing Contractors Association (MRCA) as endorsed by the Asphalt Roofing Manufacturers Association (ARMA) and the United Union of Roofers, Waterproofers and Allied Workers. Application procedures must comply with NFPA 241, OSHA 29 CFR 1910 and 29 CFR 1910.12, 29 CFR 1926.16, 29 CFR 1926 Subpart F.[, UL Fire Resistance Directory Volume No. 1, NRCA R&W Manual, and Florida Building Code Volume 2004.]

Do not store flammable liquids on the roof.

Provide a minimum of two 2.65 gallon containers of water and two fully charged minimum [20 pound CO2][20 pound ABC (dry chemical)] fire extinguishers in separate, easily accessible locations on the roof and within [30 foot][10 foot] of each [torch work area][hot-mopped kettle] at all times.

No AsphaltKettles are allowed on roofs. Locate kettles and supply LP-Gas Cylinders safely and secured per NFPA 241 outside of the building's perimeter a minimum of 20 foot from the structure and any combustible materials.

Maintain a minimum separation of 20 foot between LP-Gas Cylinders and kettle. Provide protective fire retardant blanket barrier or shield between any building structure to a minimum height of 8 foot and a clear surround distance of 4 foot if operations force placement of kettle within a distance of 20 foot. Do not obstruct or place kettles or Cylinder storage within 10 foot of exits, means of egress, gates, roadways, entrances. Locate kettles downwind and away from any building air intakes.

Provide a minimum of two portable fully charged [20 pound CO2] [20 pound ABC (dry chemical)] fire extinguishers no closer than 5 foot and

no further than 25 foot of horizontal travel distance from each kettle at all times while kettle is in operation, in easily accessible and identifiable locations. Also provide [a minimum of one][two] multipurpose 2-A:20-B:C portable fire extinguisher on the roof being covered or repaired.

Comply with the following safety procedures:

a. Fuel containers, burners, and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating must comply with the requirements of NFPA 58.

b. Fuel containers having capacities greater than one pound must be located a minimum of 10 foot clear distance from the burner flame.

c. All LP-Gas Cylinders must be clearly labeled "Flammable Gas", and secured to prevent accidental tip-over.

d. Check all pressure regulators and hoses prior to use for proper functioning and integrity.

e. Turn off fuel supply at LP Gas Cylinder when kettle is not in use.

f. Equip all kettles with a functioning temperature measuring device to ensure no heating in excess of 50 degrees F below the flash point.

g. Provide covers, lid, or top which are close fitting, constructed of minimum No.14 manufacturer's gauge steel, and can be gravity closed on all kettles.

h. Clean all roofing mops and rags free of excess asphalt and store safely away from all combustible materials. Store discarded roofing mops and rags in a non-combustible container and remove from site each day.

i. Position all pump lines handling hot asphalt securely and equip all pump lines with a shut-off valve on each with a coupler which may be opened when lines are full. Do not subject pump lines to pressures in excess of safe and recommended NRCA and ARMA working pressures. Station an operator near the equipment to cut off flow and care for other emergencies while conducting heating, pumping and application operations.

j. Asphalt bucket used by roofers or workers in similar trades must be constructed of minimum No. 24 gauge or heavier sheet steel and have a metal bail of no less than 1/4 inch diameter material. The bail is to be fastened to offset ears or equivalent which have been riveted, welded, or otherwise safely and securely attached to the bucket. Soldered bail sockets are prohibited. Position workers and other employees to avoid being struck by bucket or other roofing materials, which may accidentally fall while being hoisted, lowered, or used in the roofing operation. Provide safety barriers and caution signs at all skylights or other roof holes.

k. Do not use flammable liquids with a flash point below100 degrees F (gasoline and similar products) for cleaning purposes.

Do not use solid fuel or Class I liquids as fuel for roofing asphalt kettles. Provide a minimum of one employee fully knowledgeable of kettle operations and hazards to maintain constant surveillance during kettle operation within a minimum distance of 25 foot of the kettle.

Check all fire extinguishers prior to commencement of work, and upon completion of the day's work, to ensure fullness and operability.

Project supervisor must make daily inspections with the facility manager of all conditions and operations which could present hazards during [torching][hot-mopped] applications and issue directives to address all such concerns and items of the work and existing conditions.

Identify and protect all combustible roof components, possible fire traps, and hidden hazards. Seal off voids or openings in the substrate with non-combustible materials prior to installing [torch-applied][hot-mopped applied] materials in the area. Install protective fire retardant blankets and shields at building walls, eaves, parapets and equipments curbs constructed of combustible materials within 3 foot radius of the area of [torch work][hot-mopped kettle] prior to commencement of the work.

When working around intakes and openings, temporarily disconnect and block to prevent [flame of torch][fumes from kettle] from being drawn into the opening.[Provide non-combustible shielding or flame guard protection where gaps or voids occur in the construction in area of torch work.]

1.7.2 Fire Watch

All personnel on the roof during [torch application][hot-mopped application] must be properly trained to use a fire extinguisher. Provide a fire watch for a minimum of [two hours after completion of all torch work][30 minutes after completion of hot-mopped kettle operations] at the end of each work shift. Maintain the fire watch for additional time required to ensure no potential ignition conditions exist. [Utilize heat sensing meters to scan for hot spots in the work.][For torch applications, provide and utilize a minimum of one certified heat detection gun per torch for use during the fire watch to verify cool, safe and non-combustible conditions exist. Provide a minimum duration fire watch of two hours conducted by personnel properly trained to survey the underside of the roof deck (where possible) and the topside of possible smoldering elements.]

Do not torch in areas of poor and/or no visibility (curbs, corners, eaves, expansions joints, flashing, other voids and small penetrations) which could allow a torch flame to ignite combustible material(s) hidden from view or within the underside of the roof deck or building interior. Use cold finish applications in these areas whenever possible and per manufacturer's printed instructions, NRCA 4002, MRCA R&NW manual for "cold adhered" materials.

Do not leave the rooftop unattended during breaks in work during a work shift. Walk and scan all areas of application checking for hot spots, fumes, or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift.

1.7.3 Open Flame Application (Torch) Equipment and Personnel Safety

Only NRCA/MRCA CERTA certified roofing applicators are allowed to operate any torching equipment. Verify that all such applicators maintain and are currently carrying a valid Certified Roofing Torch Applicator (CERTA) card.

All crew members must be trained in preventive measures for indirect and direct dangers and hazards associated with roofing work, which include, but

are not limited to the following:

a. Heat Stress: Wear light colored clothing, a hat for ultra-violet protection, and other eye protective devices. Drink sufficient quantities of non-alcoholic, non-caffeine liquids. Stage shifts for crew members to allow for breaks from heat and sun exposure without interfering with work progress.

b. First Aid for Burns: Immediately call for an ambulance. Contact local Occupational Health Services (OHS).

All crew members must wear correct personal protective equipment (PPE), including. but not limited to the following items:

a. Long-sleeved shirts buttoned at the collar and cuffs,and must be made of non-flammable materials. Polyester materials are not allowed.

b. Work boots covering ankles with rubber or composite soles.

c. Long pants without cuffs to extend over the top of the work boots, and must be made of non-flammable materials. No polyester allowed.

d. Heavy leather gloves and/or flame retardant gauntlets which must be worn during all handling of a torch, whether operating or not.

e. OSHA and ANSI/ISEA Z87.1 approved face shields, goggles and/or safety glasses to be worn during torching and any other applicable roofing functions.

f. OSHA and ANSI approved hard hats.

1.7.4 Wind Conditions

Use side shields with all torching operations when winds are occurring to prevent flame distortion of end burners. Use torch machine equipment with bottom shield plate to prevent flame spread on to roof deck and substrate. When high wind gusts are present, notify the safety officer and cease all use of torching equipment until wind conditions lower and authorization from the safety officer to proceed is received.

]1.8 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counter flashing, per NRCA Details, and are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. [Application of roofing must immediately follow application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.]

1.9 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Minimum manufacturer warranty shall have no dollar limit, cover full system water-tightness, and shall have a minimum duration of 20

years.

1.9.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation in compliance with [ASTM C1289], and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

c. Upon completion of installation, and acceptance by the [Contracting Officer] [, Architect][, Construction Manager] and Roofing System Engineer of Record, the manufacturer must supply the appropriate warranty to the Owner.

d. Installer must submit a minimum two year warranty to the membrane manufacturer from the date of acceptance, with a copy to the [Contracting Officer] [, Architect][, Construction Manager] and Roofing System Engineer of Record.

1.9.2 Roofing System Installer Warranty

The roof system installer must warrant for a period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.9.3 Continuance of Warranty

Repair or replacement work, ARMA 410BUR88, NRCA C3701 that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.10 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system must be in accordance with specified and indicated requirements, including fire and wind resistance (ANSI/SPRI/FM 4435/ES-1) requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA Roofing and Waterproofing Manual, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval prior to installation.

1.11 ELIMINATION, PREVENTION OF FALL HAZARDS

1.11.1 Fall Protection

[_____]

1.12 COOL ROOFS

[Meet the ASHRAE 90.1 - IP Chapter 5 values for cool roofing. If a cool roof is not selected in zones 1-3, meet one of the exception requirements listed in ASHRAE 90.1 - IP Chapter 5 or provide thermal insulation above the deck with an R value of 33 or greater.

]1.13 SUSTAINABILITY REPORTING

Coordinate with Section 01 33 29 LEED(tm) DOCUMENTATION.

1.13.1 Recycled Materials

Contractor shall select materials so that the sum of post-consumer recycled content value plus one-half of post-industrial recycled content value constitutes at least [10][20][_____] percent of the total materials cost for the project. EPA Comprehensive Procurement Guidelines has a supplier database: http://www.epa.gov/cpg/products/

1.13.2 Local/Regional Materials

[Contractor shall select materials so that a minimum of [10][20][_____] percent (by dollar value) of materials and products for the project are extracted, harvested, or recovered, as well as manufactured, regionally within a 500 mile radius of the project site.] [The following technical sections include regional material requirements so that, if available, a minimum of [10][20][_____] percent (by dollar value) of materials and products for the project are extracted, harvested, or recovered, as well as manufactured, regionally within a 500 mile radius of the project site: [_____].

]PART 2 PRODUCTS

2.1 MODIFIED BITUMEN SHEETS AND FIBERGLASS FELT MATERIALS

Furnish a combination of specified materials that comprise the modified bitumen manufacturer's standard system of the number and type of plies specified. Materials provided must be suitable for the service and climatic conditions of the installation. Modified bitumen sheets must be watertight and visually free of pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might

affect serviceability. Polymer modifier must comply with ARMA PMBRG98 and be uniformly dispersed throughout the sheet. Edges of sheet must be straight and flat.

[a. Venting Base Sheet: ASTM D4897/D4897M, Type II, [without][with] perforations and as approved by the modified bitumen roof membrane manufacturer.

][b. Fiberglass Felt Base Sheet: ASTM D4601/D4601M,ASTM D1668/D1668M Type II, [without][with] perforations and as approved by the modified bitumen roof membrane manufacturer.

]
[c. SBS Base Sheet: [ASTM D6162/D6162M] [or] [ASTM D6164/D6164M] [or] [ASTM D6163/D6163M], Type [I or] II, Grade S, minimum 80 mils thick.

][d. SBS Interply Sheet: [ASTM D6162/D6162M] [or] [ASTM D6164/D6164M] [or] [ASTM D6163/D6163M], Type [I or] II, Grade S, minimum 80 mils thick.
]
[e. SBS Cap Sheet: [ASTM D6162/D6162M] [or] [ASTM D6164/D6164M] [or] [ASTM D6163/D6163M]; Type II, Grade [G][S], minimum [145 mils] [_____] thick, and as required to provide specified fire safety rating.

]
[f. APP Base Sheet: ASTM D6222/D6222M, Type I or II; or ASTM D6223/D6223M; Grade [G][S], minimum 140 mils thick.

]
[g. APP Cap Sheet: ASTM D6222/D6222M, Type II; or ASTM D6223/D6223M; Grade [G][S], minimum 160 mils thick.

]2.2 BASE FLASHING MEMBRANE

Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the roof membrane specified and as recommended in membrane manufacturer's published literature. Flashing membranes must meet or exceed the properties of the material standards specified for the modified bitumen [base][, interply] and cap sheet, except that flashing membrane thickness must be as recommended by the membrane manufacturer.[Metal clad flashing membrane must comply with ASTM D6298].

[2.3 ASPHALT

ASTM D312/D312M, Type III or IV, in accordance with modified bitumen membrane manufacturer requirements and compatible with the slope conditions of the installation.

][2.4 COLD-APPLIED MEMBRANE ADHESIVE

Membrane manufacturer's recommended [low volatile organic compound (VOC)] cold process adhesive for application of the membrane plies.

][2.5 MEMBRANE SURFACING

Provide modified bitumen roof membrane cap sheet with factory-applied granule surfacing of [light][_____] color [as selected from membrane manufacturer's standard colors].[Provide modified bitumen membrane manufacturer's recommended field-applied protective coating of [white][light gray][_____] color. [Aluminized coating must comply with

ASTM D2824/D2824M, Type I or III, as recommended by the modified bitumen roof membrane manufacturer].][Light colored, opaque water-worn gravel aggregate surfacing material conforming to ASTM D1863/D1863M, or other aggregate as recommended by the membrane manufacturer and approved by the Contracting Officer[, and applied in flood coat of hot asphalt].]

]2.6 PRIMER

ASTM D41/D41M, or other primer compatible with the application and as approved in writing by the modified bitumen membrane manufacturer.

2.7 MODIFIED BITUMEN ROOF CEMENT

ASTM D4586/D4586M, Type II for vertical surfaces, Type I for horizontal surfaces, compatible with the modified bitumen roof membrane and as recommended by the modified bitumen membrane manufacturer.

2.8 CANT AND TAPERED EDGE STRIPS

Provide standard cants and tapered edge strips of [perlite conforming to ASTM C728][the same material as the roof insulation][or when roof insulation material is not available, provide pressure preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the manufacturer.] [or wood fiber conforming to ASTM C208] treated with bituminous impregnation, sizing, or waxing and fabricated to provide maximum 45 degree change in direction of membrane. Cant strips must be minimum [1-1/2 inch thick and provide for minimum 5 inch face and 3-1/2 inch vertical height when installed at 45 degree face angle][4 inch vertical height with 45 degree cant angle], except where clearance restricts height to lesser dimension. Taper edge strips at a rate of one to 1-1/2 inch per foot to a minimum of 1/8 inch of thickness. Provide kiln-dried preservative-treated wood cants, in compliance with requirements of Section 06 10 00 ROUGH CARPENTRY at base of wood nailers set on edge and wood curbing and where otherwise indicated.

2.9 FASTENERS AND PLATES

Provide coated, corrosion-resistant fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470 and FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. For fastening of membrane or felts to wood materials, provide fasteners driven through 1 inch diameter metal discs, or one piece composite fasteners with heads not less than 1 inch in diameter or 1 inch square with rounded or 45 degree tapered corners.

2.9.1 Masonry or Concrete Walls and Vertical Surfaces

Use hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 1 inch long for securing felts, modified bitumen sheets, metal items, and accessories to masonry or concrete walls and vertical surfaces. Use power-driven fastenersonly when approved in writing by the Contracting Officer.

2.9.2 Metal Plates

Provide flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; not less than 2 inch in diameter. Form discs to prevent dishing or cupping.

[2.10 PRE-MANUFACTURED ACCESSORIES

Pre-manufactured accessories must be manufacturer's standard for intended purpose,[comply with applicable specification section,] compatible with the membrane roof system and approved for use by the modified bitumen membrane manufacturer.

[2.10.1 Pre-fabricated Curbs

Provide [_____] gauge [G90 galvanized][AZ55 galvalume][_____] curbs with minimum 4 inch flange for attachment to roof nailers. Curbs must be minimum height of 10 inch above the finished roof membrane surface.

][2.10.2 Elevated Metal [Walkways] [and] [Platforms]

As specified in Section[05 50 13 MISCELLANEOUS METAL FABRICATIONS][05 51 33 METAL LADDERS][05 52 00 METAL RAILINGS][05 51 00 METAL STAIRS].

]][2.11 WALKPADS

Roof walkpads must be polyester reinforced, granule-surfaced modified bitumen membrane material, minimum [_____][197] mils thick, compatible with the modified bitumen sheet roofing and as recommended by the modified bitumen sheet roofing manufacturer. Panels must not exceed 4 foot in length. Other walkpad materials require approval of the Contracting Officer prior to installation.

][2.12 PAVER BLOCKS

Precast concrete, minimum 1-1/2 inch thick, minimum 18 inch square for walkways and minimum 6 inch by 12 inch for use in supporting surface bearing components but extending not less than 2 inch beyond all sides of surface bearing bases. Install walkpad material under all paver blocks.

][2.13 ROOF INSULATION BELOW MODIFIED BITUMEN MEMBRANE SYSTEM

Insulation must be compatible with the roof membrane, approved by the membrane manufacturer and meeting all the requirements of [ASTM C552][ASTM C578][ASTM C726] as specified in Section 07 22 00 ROOF AND DECK INSULATION.

]2.14 MEMBRANE LINER

Provide self-adhering modified bitumen underlayment conforming to ASTM D1970/D1970M, EPDM membrane liner conforming to ASTM D4637/D4637M, or other waterproof membrane liner material as approved by the Contracting Officer.

2.15 Photovoltaic (PV) Systems - Rack Mounted Systems

The Contractor shall adhere to the following guidelines:

a. Building Owners Guide to Roof-mounted PV Systems, published by NRCA.

b. Guidelines for Roof-Mounted PV Systems, published by NRCA.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. [Drains,] [curbs,] [cants,] [control joints,] [expansion joints,] [perimeter walls,] [roof penetrating components,] [and] [equipment supports] are in place.

b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.

c. The plane of the substrate does not vary more than 1/4 inchwithin an area 10 by 10 foot when checked with a10 foot straight edge placed anywhere on the substrate.

d. Substrate is sloped as indicated to provide positive drainage.

e. Walls and vertical surfaces are constructed to receive counter flashing, and will permit mechanical fastening of the base flashing materials.

f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inch above finished roofing surface.

g. Protect all combustible materials and surfaces which may contain concealed combustible or flammable materials. All fire extinguishing equipment has been placed as specified.

h. Verify all Fire Watch personnel assignments.

i. Treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures. [Embedded nailers are flush with deck surfaces.] [Surface-applied nailers are the same thickness as the roof insulation.]

j. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than 3-1/2 inch.

[k. Venting is provided in accordance with the following:

[(1) Edge Venting: Perimeter nailers are kerfed across the width of the nailers to permit escape of gaseous pressure at roof edges.

][(2) Underside Venting: Vent openings are provided in steel form decking for cast-in-place concrete substrate.

]]l. Exposed nail heads in wood substrates are properly set. Warped and split [boards] [sheets] have been replaced. There are no cracks or end joints 1/4 inch in width or greater. Knot holes are covered with sheet metal and nailed in place. [Wood] [Plywood] decks are covered with rosin paper or unsaturated felt prior to base sheet or roof membrane application.[Joints in plywood substrates are taped or otherwise sealed

to prevent air leakage from the underside.

][m. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

][n. Cast-in-place substrates have been allowed to cure and the surface dryness requirements specified under paragraph entitled "Field Quality Control" have been met.

][o. Joints between precast concrete deck units are grouted, leveled, and stripped in with felt or bituminous stripping membrane set in bituminous cement prior to applying other roofing materials over the area.

] p. Roof deck and framing are sloped as indicated to provide positive drainage.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoists[, tankers][, and kettles] prior to starting the work. Lap protective coverings not less than 6 inch, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

[3.2.1.2 Bitumen Stops

Provide felt bitumen stops or other means to prevent bitumen drippage at roof edges, openings, and vertical projections before hot mopped application of the roofing membrane.

][3.2.2 Equipment

[3.2.2.1 Mechanical Application Devices

Mount mechanical application devices on pneumatic-tired wheels. Use devices designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

][3.2.2.2 Flame-Heated Equipment

Do not place flame-heated equipment on roof. Provide and maintain a fire extinguisher adjacent to flame-heated equipment and on the roof.

][3.2.2.3 Open Flame Application Equipment

Torches and other open flame equipment must be specifically designated for use in application of modified bitumen materials and approved by the modified bitumen sheet manufacturer. Open flame equipment must not be ignited (burning) when left unattended. Provide and maintain a fire extinguisher adjacent to open flame equipment on the roof. Specific requirements for fire watches and burn permits exist. These requirements will be reviewed at the preroofing conference.

]3.2.2.4 Electric-Heated Equipment

Provide adequate electrical service as required by manufacturer of electrical equipment to ensure against damage to equipment and property and to ensure proper application of roofing materials.

][3.2.3 Heating of Asphalt

Break up solid asphalt on a surface free of dirt and debris. Heat asphalt in kettle designed to prevent contact of flame with surfaces in contact with the asphalt. Kettles must have visible working thermometer and thermostatic controls set to the temperature limits specified herein. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus 1.8 degrees F, to check temperatures of the asphalt frequently. When temperatures exceed maximums specified, remove asphalt from the site. Do no permit cutting back, adulterating, or fluxing of asphalt.

[3.2.3.1 Temperature Limitations for Asphalt

Heat and apply asphalt at the temperatures specified below unless specified otherwise by manufacturer's printed application instructions. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its finished blowing temperature (FBT). Do not heat asphalt between 500 and 525 degrees F for longer than four consecutive hours. Do not heat asphalt to the flash point (FP). Apply asphalt and embed membrane sheets when temperature of asphalt is within plus or minus 25 degrees F of the equiviscous temperature (EVT) but not less than 400 degrees F. Before heating and application of asphalt refer to the asphalt manufacturer's label or bill of lading for FP, FBT, and EVT of the asphalt used.

]]3.2.4 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 0.75 gallon per 100 sq. ft. or as recommended by modified bitumen sheet manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane applications.

3.2.4.1 Priming of Concrete and Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive membrane materials uniformly with primer.

3.2.4.2 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roof system prior to setting in bituminous materials or stripping into roofing system.

3.2.5 Membrane Preparation

Unroll modified bitumen membrane materials and allow to relax a minimum of 30 minutes prior to installation. In cold weather, adhere to membrane manufacturer's additional recommendations for pre-installation membrane handling and preparation. Inspect for damage, pinholes, particles of

foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Edges of seams must be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles. Discard damaged or defective materials.

3.2.6 Substrate Preparation

Apply membrane to clean, dry surfaces only. Do not apply membrane to surfaces that have been wet by rain or frozen precipitation within the previous 12 hours. Provide cleaning and artificial drying with heated blowers or torches as necessary to ensure clean, dry surface prior to membrane application.

3.3 APPLICATION

Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt. [Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system.]

3.3.1 Phased Membrane Construction

Phased application of membrane plies is prohibited unless otherwise approved by the Contracting Officer and supported by the membrane manufacturer's written application instructions. If cap sheet installation is delayed, thoroughly clean the applied membrane material surface and dry immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the Contracting Officer prior to cap sheet installation.

3.3.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing [cooling towers,] [antennas,] [pipes,] [ducts,] [_____,] is to be performed on the roof or where construction scheduling or weather conditions require protection of the building's interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing.

[3.3.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of the permanent roofing system.

]3.3.3 Application Method

[3.3.3.1 Hot Asphalt Application of Modified Bitumen Membrane

Apply membrane immediately following application of hot asphalt. Apply hot asphalt within 6 foot of roll. Do not work ahead with asphalt. Asphalt must be completely fluid, with mop temperatures within the asphalt's EVT range, but not less than 400 degrees F, at the instant membrane comes into contact with asphalt. Application of bitumen between layers must be such as to provide full, continuous, uniform coverage and complete contact of hot asphalt with the sheet above and below. Embed sheets in asphalt. As

sheets are being rolled into hot asphalt, immediately and thoroughly apply uniform positive pressure by squeegee, roll, or broom to ensure full adhesion and lap seal, eliminate trapped air and to provide tight, smooth laminations. Avoid excessive extrusion of asphalt at lap areas. Control asphalt bleed out to approximately 1 inch maximum.

]3.3.3.2 Torch Applied [Heat Welded] Modified Bitumen Membrane [Flashing]

[Base flashing membrane may be torch applied.] Ensure substrate membrane surfaces are warmed either naturally or by torch during the installation. Apply heat evenly to underside of roll membrane being installed and exposed side lap area of previously installed sheet. Provide for slight, uniform flow of bitumen in front of roll and full width of roll as the material is being rolled or set into place. Apply uniform positive pressure to ensure membrane is fully adhered and all laps are sealed. Prior to forming lap over granulated surfaces, embed granules of the receiving sheet by heating and troweling-in the granules to form a uniform black compound surface. [Roll all lap areas with a weighted roller immediately after forming lap. Provide for visual bleed out of compound in lap areas.][Avoid overheating the membrane or burning through to membrane reinforcement. Inspect and ensure all lap areas are fully sealed.

][3.3.3.3 Cold Adhesive Applied Modified Bitumen Membrane

Apply cold adhesive with airless sprayer or 1/4 inch saw-toothed rubber squeegee to prepared surfaces in accordance with membrane manufacturer's application instructions. Fully cover substrate with adhesive. Roll or lay membrane in adhesive in accordance with manufacturer's recommendations and within the time limitations of adhesive application. Broom the membrane to ensure full contact with adhesive. Seal laps with adhesive or by heat fusing with torch or hot air welder as required by membrane manufacturer. Minimize traffic on installed membrane during the adhesive cure and set time.

][3.3.4 Ventilating Base Sheets

Apply ventilating base sheets with 3 inch side laps and 6 inch end laps in accordance with manufacturer's printed application instructions for substrate [and wind uplift conditions]specified. [Mechanical attachments must be as required for wind resistance specified and to include increased frequency of attachment at corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate.] [Top mop perforated sheet with a full, continuous mopping of hot asphalt.]

]3.3.5 [Fiberglass Felt][Modified Bitumen] Base Sheet

[Fully adhere [spot adhere] base sheets in accordance with membrane manufacturer's printed instructions.] [Spot adhesion must be with hot asphalt applied in 12 inch diameter spots installed in two staggered rows, centered 12 inch in from edge of the base sheet.][Apply cold adhesive with airless sprayer or a 1/4 inch saw-toothed rubber squeegee and at application rate recommended by the membrane manufacturer. Fully cover substrate with cold adhesive. Ensure laps areas of base sheet are fully sealed.] Roll and broom in the base sheet to ensure full contact with the [hot asphalt][adhesive] application. [On nailable substrates, mechanically fasten base sheet in conformance with specified wind resistance requirements and membrane manufacturer's printed instructions, and to include increased fastening frequency in corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Where

applicable, mechanically fasten base sheet in conjunction with insulation to the substrate, in accordance with membrane manufacturers printed instructions.] Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 2 inch unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 6 inch and staggered a minimum of 36 inch. Apply sheets [at right angles to the roof slope so that the direction of water flow is over and not against the laps] [parallel to the roof slope] [so that plies of sheets extend from eave line on one side of the barrel-type roof and 18 inch over the center line of the crown of the roof. Apply sheets on the other side in the same manner, resulting in twice the normal amount of roofing sheets and asphalt at the crown]. Extend base sheets approximately 2 inch above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Application must be free of ridges, wrinkles, and buckles.

3.3.6 Modified Bitumen Membrane Application

Ensure proper sheet alignment prior to installation. [Apply membrane layers perpendicular to slope of roof in shingle fashion to shed water, including application on areas of tapered insulation that change slope direction.][Apply membrane layers parallel to slope of roof.] Bucking or backwater laps are prohibited. Fully adhere membrane sheets to underlying substrate materials. Provide minimum 3 inch side laps and minimum 6 inch end laps and as otherwise required by membrane manufacturer. Stagger end laps minimum 36 inch. Offset side laps between membrane layers a minimum of 12 inch. Offset end laps between membrane layers a minimum of 36 inch. Install all membrane layers the same workday, unless supported otherwise by roof membrane manufacturer application instructions and approved by the Contracting Officer. Provide tight smooth laminations of each membrane layer without wrinkles, ridges, buckles, kinks, fishmouths, or voids. Ensure full membrane adhesion and full lap seals. Rework to seal any open laps prior to application of subsequent membrane layers. The completed membrane application must be free of surface abrasions, air pockets, blisters, ridges, wrinkles, buckles, kinks, fishmouths, voids, or open seams.

3.3.6.1 Cap Sheet Installation

Underlying applied membrane must be inspected and repaired free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Do not apply cap sheet if rain or frozen precipitation has occurred within the previous 24 hours. Align cap membrane and apply by the specified method with the proper side and end lap widths. [Set cap sheet in hot asphalt or torch apply as recommended by the modified bitumen membrane manufacturer.] Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. [Apply matching granules in any areas of [bitumen][adhesive] bleed out while the [asphalt is still hot][adhesive is still tacky].] Minimize traffic on newly installed cap sheet membrane.

[3.3.6.2 Backnailing of Cap Sheet

Unless otherwise recommended by the modified bitumen membrane manufacturer and approved by the Contracting Officer, provide minimum 3-1/2 inch wide nailing strips matching insulation thickness and applied perpendicular to

roof slope for backnailing of roof membrane. Space nailing strips as recommended by the membrane manufacturer, but not exceeding 16 foot on center unless approved otherwise by the Contracting Officer. Coordinate the nailer installation with insulation requirements. Install the modified bitumen cap sheet to provide for end laps at nailer locations. Nail the modified bitumen cap sheet at the end lap area across the width of the sheet. Nail within 1 inch of each edge of the sheet and at 8 inch to 8-1/2 inch on center across the width of the sheet in a staggered fashion. Nails must have 1 inch diameter metal cap or be nailed through 1 inch diameter caps. Cover nails by overlapping adjacent upslope sheet at the end lap area.

]3.3.7 Membrane Flashing

Apply two-ply modified bitumen strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Apply membrane flashing in accordance with the roof membrane manufacturers printed instructions and as specified. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of modified bituminous base flashing 150 mm (6 inches) on center through minimum 1 inch diameter tin caps with fasteners of sufficient length to embed minimum one inch into attachment substrate.[Apply matching granules in any areas of [asphalt][adhesive] bleed out while the [asphalt is still hot][adhesive is still tacky].] Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components. Metal flashing per SMACNA 1793 guidelines and standards is specified under Section 07 60 00 FLASHING AND SHEET METAL. Do not set metal flashing in hot asphalt.

3.3.7.1 Membrane Strip Flashing

Set primed flanges of metal flashing in full bed of modified bituminous cement material and securely fasten through to attachment substrate. Strip-in with membrane flashing so that strip extends not less than 4 inch beyond outer edge of flange. Where multiple membrane stripping plies are installed, extend each additional stripping ply minimum 4 inch beyond edge of previous ply.

[3.3.7.2 Membrane Flashing at Roof Drain

Roof drains are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Flashing for roof drains, is specified in Section 07 60 00 FLASHING AND SHEET METAL. Extend membrane sheets to edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Securely clamp membrane sheets and metal roof drain flashing and strip flashing in the flashing clamping ring. Secure clamps so that sheets and metal flashing are free from wrinkles and folds. Trim stripping must be flush with inside of clamping ring.

][3.3.7.3 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flash with modified bitumen membrane.

]3.3.7.4 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.7.5 Lightning Protection

Flash and attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacturer.

3.3.8 Roof Walkpads

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Provide minimum 6 inch separation between adjacent walkpads to accommodate drainage. Provide walkpad [or an additional layer of cap sheet] under precast concrete paver blocks to protect the roofing.

[3.3.9 Elevated Metal [Walkways] [and] [Platforms]

Install over completed roof system in accordance with [Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][Section 05 51 33 METAL LADDERS][Section 05 52 00 METAL RAILINGS][Section 05 51 00 METAL STAIRS]. Provide for protection of roof membrane by placing walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

]3.3.10 Paver Blocks

Install paver blocks where indicated and as necessary to support surface bearing items traversing the roof area. Set paver block on a layer of walkpad [or cap sheet] applied over the completed roof membrane.

[3.3.11 Field Applied Surfacing

After completion of roof membrane and flashing installation, and correction of tears, gouges, and other deficiencies in the installed work, apply specified surfacing.

[3.3.11.1 Aggregate

Uniformly flood coat the surface with hot asphalt at a rate of approximate 60 pounds per square. While asphalt is still hot, apply gravel aggregate surfacing material at a rate of 400 pounds per square or 300 pounds per square for slag or other approved aggregate surfacing. Provide for full and uniform coverage of the roof surface. Solidly adhere approximately 50 percent of the aggregate in the asphalt.

][3.3.11.2 Coating Application

Apply surface coating materials to membrane and flashing in accordance with coating material manufacturer's recommendations.

]]3.3.12 Correction of Deficiencies

Where any form of deficiency is found, additional measures will be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions must be performed as directed by the Contracting Officer.

3.3.13 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.4 CORRECTION OF DEFICIENCIES

Where any form of deficiency is found, additional measures must be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions must be as directed by the Contracting Officer.

3.5 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system from water intrusion.

[3.5.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system in an effective manner. [Seal off flutes in metal decking along the cutoff edge.] Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

]3.5.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashing can be applied. Remove temporary flashing before applying permanent flashing.

3.5.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.6 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

[3.6.1 Test for Surface Dryness

Before application of membrane sheets and starting work on the area to be roofed, perform test for surface dryness in accordance with the following:

a. Foaming: When poured on the surface to which membrane materials are to be applied, one pint of asphalt when heated in the range of 350 to 400 degrees F, must not foam upon contact.

b. Strippability: On cementitious substrate surfaces, after asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from the surface, do not consider the surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been tested by the method above and found dry.

c. Prior to installing any roof system on a concrete deck, conduct a test per ASTM D4263. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

]3.6.2 Construction Monitoring

During progress of the roof work, Contractor must make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Materials comply with the specified requirements.

b. Materials are not installed in adverse weather conditions.

All materials are properly stored, handled and protected from moisture or other damages.

c. Equipment is in working order. Metering devices are accurate.

d. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

(1) Nailers and blocking are provided where and as needed.

Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

(2) The proper number, type, and spacing of fasteners are installed.

Membrane heating, hot mopping, or adhesive application is provided uniformly and as necessary to ensure full adhesion of roll materials. Asphalt is heated and applied within the specified temperature range.

The proper number and types of plies are installed, with the specified overlaps.

Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

(3) Lap areas of all plies are completely sealed.

Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.

Installer adheres to specified and detailed application parameters.

Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Temporary protection measures are in place at the end of each work shift.

[3.6.2.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three [_____] times [once per week] during the installation for purposes of reviewing materials installation practices and adequacy of work in place. [Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections must not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer.] After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

]3.6.3 Samples of Roofing

Take samples per ASTM D5147/D5147M, sized 4-inch by 40-inch cut across width of modified bitumen sheets as directed by the Contracting Officer. Cut samples will be examined by the Contracting Officer for specified number of plies, proper lap width, complete lap seal, full uniform adhesive compound application and adhesion, full bond between plies, harmful foreign materials, presence of moisture, and wet insulation. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area in bed of modified bitumen cement. Repair area of cut with new minimum two-ply modified bitumen membrane patch.

3.6.4 Roof Drain Test

After completing roofing, but prior to Government acceptance, perform the following test for watertight integrity. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

[3.7 INFRARED INSPECTION

[Eight][_____] months after completion of the roofing system, the Contractor must inspect the roof surface using infrared (IR) scanning as specified in ASTM C1153. Where the IR inspection indicates moisture intrusion, wet insulation and damaged or deficient materials or construction must be replaced in a manner to provide watertight construction and maintain the specified roof system warranties.

]3.8 INSTRUCTIONS TO [GOVERNMENT][CONTRACTOR] PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the modified bitumen membrane manufacturer and include a

minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.9 INFORMATION CARD

For each roof, furnish a typewritten information card for facility Records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.039 inch thick aluminum card for exterior display. Card must be 8 1/2 by 11 inch minimum. Information card must identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. The card must be a minimum size of 8 1/2 by 11 inch. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

-- End of Section --

SECTION 07 61 14.00 20

STEEL STANDING SEAM ROOFING
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 IRON AND STEEL INSTITUTE (AISI)

AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set

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 A1011/A1011M	(2014) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
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 D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
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 D4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D522/D522M	(2014) Mandrel Bend Test of Attached Organic Coatings
ASTM D523	(2014) Standard Test Method for Specular Gloss
ASTM D714	(2002; R 2009) Evaluating Degree of Blistering of Paints
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 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

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

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

1.2 DEFINITIONS

1.2.1 Field-Formed Seam

Seams of panels so configured that when adjacent sheets are installed the seam is sealed utilizing mechanical or hand seamers. Crimped (45 degree bend), roll formed (180 degree bend), double roll formed (2 - 180 degree bends), and roll and lock systems are types of field-formed seam systems.

1.2.2 Pre-Formed

Formed to the final, less field-formed seam, profile and configuration in the factory.

1.2.3 Field-Formed

Formed to the final, less field-formed seam, profile and configuration at the site of work prior to installation.

1.2.4 Roofing System

The roofing system is defined as the assembly of roofing components, including roofing panels, flashing, fasteners, and accessories which, when assembled properly result in a watertight installation.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

a. Panels shall be continuous lengths up to manufacturer's standard longest lengths, with no joints or seams, except where indicated or specified. Ribs of adjoining sheets shall be in continuous contact from eave to ridge.

b. There shall be no exposed or penetrating fasteners except where shown on approved shop drawings. Fasteners into steel shall be stainless steelinserted into predrilled holes. There shall be a minimum of two fasteners per clip. Single fasteners will be allowed when supporting structural members are prepunched or predrilled.

c. Roof panel anchor clips shall be concealed and designed to allow for longitudinal thermal movement of the panels, except where specific fixed points are indicated. Provide for lateral thermal movement in panel configuration or with clips designed for lateral and longitudinal movement.

1.3.2 Design Conditions

The system shall be designed to resist positive and negative loads specified herein in accordance with the AISI SG03-3. Panels shall support walking loads without permanent distortion or telegraphing of the structural supports.

1.3.2.1 Wind Uplift

The design uplift pressures for the roof system shall be computed and applied using a basic wind speed of 90 miles per hour (mph). Roof system and attachments shall resist the following wind loads, in pounds per square foot (psf):

	Negative
a. At eaves	51
b. At rakes	51
c. At ridge	35
d. At building corners	15
e. At central areas	20

The design uplift force for each connection assembly shall be that pressure given for the area under consideration, multiplied by the tributary load area of the connection assembly, and multiplied by the appropriate factor of safety, as follows:

a. Single fastener in a connection: 3.0

b. Two or more fasteners in each connection: 2.25

1.3.2.2 Roof Live Loads

Loads shall be applied on the horizontal projection of the roof structure. The minimum roof design live load shall be 20 psf.

1.3.2.3 Thermal Movement

System shall be capable of withstanding thermal movement based on a temperature range of 10 degrees F below . 180 degrees F.

1.3.2.4 Deflection

Panels shall be capable of supporting design loads between unsupported spans with deflection of not greater than L/180 of the span.

1.3.3 Structural Performance

The structural performance test methods and requirements of the Standing Seam Roofing Systems (SSRS) shall be in accordance with ASTM E1592.

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

Roofing; G

Submit roofing drawings to supplement the instructions and diagrams. Drawings shall include design and erection drawings containing an isometric view of the roof showing the design uplift pressures and dimensions of edge, ridge and corner zones; and show typical and special conditions including flashings, materials and thickness, dimensions, fixing lines, anchoring methods, sealant locations, sealant tape locations, fastener layout, sizes, and spacing, terminations, penetrations, attachments, and provisions for thermal movement. Details of installation shall be in accordance with the manufacturer's Standard Instructions and details or the SMACNA 1793. Prior to submitting shop drawings, have drawings reviewed and approved by the manufacturer's technical engineering department.

SD-03 Product Data

Roofing panels; G

Attachment clips

Closures

Accessories

Fasteners

Sealants

Sample warranty certificate; G

Submit for materials to be provided. Submit data sufficient to indicate conformance to specified requirements.

SD-04 Samples

Roofing panel

Submit a 12 inch long by full width section of typical panel.

For color selection, submit 2 by 4 inch metal samples in color, finish and texture specified.

Accessories

Submit each type of accessory item used in the project including, but not limited to each type of anchor clip, closure, fastener, and leg clamp.

SD-05 Design Data

Design calculations

SD-07 Certificates

Manufacturer's Technical Representative's Qualifications

Statement of Installer's Qualifications

Submit documentation from roofing manufacturer proving the manufacturer's technical representative meets below specified requirements. Include name, address, telephone number, and experience record.

Submit documentation proving the installer is factory-trained, has the specified experience, and authorized by the manufacturer to install the products specified.

SD-08 Manufacturer's Instructions

Installation manual; G

Submit manufacturers printed installation manual, instructions, and standard details.

SD-11 Closeout Submittals

Information card

For each roofing installation, submit a typewritten card or photoengraved aluminum card containing the information listed on Form 1 located at the end of this section.

1.5 DESIGN CALCULATIONS

Provide design calculations prepared by a professional engineer specializing in structural engineering verifying that system supplied and any additional framing meets design load criteria indicated. Coordinate

calculations with manufacturer's test results. Include calculations for:

Wind load uplift design pressure at roof locations specified in paragraph entitled "Wind Uplift."

Clip spacing and allowable load per clip.

Fastening of clips to structure or intermediate supports.

Intermediate support spacing and framing and fastening to structure when required.

Allowable panel span at anchorage spacing indicated.

Safety factor used in design loading.

Governing code requirements or criteria.

Edge and termination details.

1.6 QUALITY ASSURANCE

1.6.1 Preroofing Conference

After submittals are received and approved but before roofing and insulation work, including associated work, is preformed, the Contractor shall hold a preroofing conference to review the following:

a. The drawings and specifications

b. Procedure for on site inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system

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

d. Safety requirements

The preroofing conference shall be attended by the Contractor and personnel directly responsible for the roofing and insulation installation, and the roofing manufacturer's technical representative. Conflicts among those attending the preroofing conference shall be resolved and confirmed in writing before roofing work, including associated work, is begun.

1.6.2 Manufacturer

The SSMRS shall be the product of a metal roofing industry - recognized manufacturer who has been in the practice of manufacturing SSMRS for a period of not less than 5 years and who has been involved in at least 5 projects similar in size and complexity to this project.

1.6.3 Manufacturer's Technical Representative

The representative shall have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place. The manufacturer's representative shall be an employee of the manufacturer

with at least 5 years experience in installing the roof system. The representative shall be available to perform field inspections and attend meetings as required herein, and as requested by the Contracting Officer.

1.6.4 Installer's Qualifications

The roofing system installer shall be factory-trained, approved by the metal roofing system manufacturer to install the system, and shall have a minimum of three years experience as an approved applicator with that manufacturer. The applicator shall have applied five installations of similar size and scope as this project within the previous 3 years.

1.6.5 Single Source

Roofing panels, clips, closures, and other accessories shall be standard products of the same manufacturer; shall be the latest design by the manufacturer; and shall have been designed by the manufacturer to operate as a complete system for the intended use.

1.6.6 Laboratory Tests For Panel Finish

The term "appearance of base metal" refers to the metal coating on steel. Panels shall meet the following test requirements:

a. Formability Test: When subjected to a 180 degree bend over a 1/8 inch diameter mandrel in accordance with ASTM D522/D522M, exterior coating film shall show only slight microchecking and no loss of adhesion.

b. Accelerated Weathering Test: Withstand a weathering test for a minimum of 2000 hours in accordance with ASTM G152 and ASTM G153, Method 1 without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with a penknife blade or similar instrument shall be considered to indicate loss of adhesion.

c. Chalking Resistance: After the 2000-hour weatherometer test, exterior coating shall not chalk greater than No. 8 rating when measured in accordance with ASTM D4214 test procedures.

d. Color Change Test:

After the 2000-hour weatherometer test, exterior coating color change shall not exceed 2 NBS units when measured in accordance with ASTM D2244 test procedure.

e. Salt Spray Test: Withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of 10, no blisters in field as determined by ASTM D714; and an average rating of 7, 1/16 inch failure at scribe, as determined by ASTM D1654. Rating Schedule No. 1.

f. Abrasion Resistance Test for Color Coating: When subjected to the falling sand test in accordance with ASTM D968, coating system shall withstand a minimum of 100 liters of sand per mil thickness before appearance of base metal.

g. Humidity Test: When subjected to a humidity cabinet test in accordance with ASTM D2247 for 1000 hours, a scored panel shall show no signs of

blistering, cracking, creepage, or corrosion.

h. Gloss Test: The gloss of the finish shall be 30 plus or minus 5 at an angle of 60 degrees, when measured in accordance with ASTM D523.

1.7 WARRANTY

Furnish manufacturer's no-dollar-limit materials and workmanship warranty for the roofing system. The warranty period shall be not less than 20 years from the date of Government acceptance of the work. The warranty shall be issued directly to the Government. The warranty shall provide that if within the warranty period the metal roofing system becomes non-watertight or shows evidence of corrosion, perforation, rupture or excess weathering due to deterioration of the roofing system resulting from defective materials or installed workmanship the repair or replacement of the defective materials and correction of the defective workmanship shall be the responsibility of the roofing system manufacturer. Repairs that become necessary because of defective materials and workmanship while roofing is under warranty shall be performed within 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time will constitute grounds for having the repairs performed by others and the cost billed to the manufacturer. The Contractor shall also provide a 2 year contractor installation warranty.

1.8 DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle preformed panels, bulk roofing products and other manufactured items in a manner to prevent damage or deformation.

1.8.1 Delivery

Provide adequate packaging to protect materials during shipment. Crated materials shall not be uncrated until ready for use, except for inspection. Immediately upon arrival of materials at the jobsite, inspect materials for damage, dampness, and staining. Damaged or permanently stained materials that cannot be restored to like-new condition shall be replaced with satisfactory material. If materials are wet, remove the moisture and re-stack and protect the panels until used.

1.8.2 Storage

Stack materials on platforms or pallets and cover with tarpaulins or other suitable weathertight covering which prevents water trapping or condensation. Store materials so that water which might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining, such as mud, lime, cement, fresh concrete or chemicals. Protect stored panels from wind damage.

1.8.3 Handling

Handle material carefully to avoid damage to surfaces, edges and ends.

PART 2 PRODUCTS

2.1 ROOFING PANELS

Panels shall be 16 inches wide and have 2 inche height interlocking ribs

for securing adjacent sheets. System for securing the roof covering to structural framing members shall be concealed clip fastening system with no fasteners penetrating the panels except at the ridge or eave, rakes, penetrations, and end laps. Backing plates and ends of panels at end laps shall be predrilled or prepunched; factory prepare ends of panels to be lapped by trimming part of seam, die-setting or swaging ends of panels. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope when such slope is 30 feet or less. When length of run exceeds 30 feet, each sheet in the run shall extend over two or more spans. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Make provisions for expansion and contraction at either ridge or eave, consistent with the type of system to be used. Panels from coil stock shall be formed without warping, waviness or ripples not part of the panel profile and shall be free of damage to the finish coating system.

2.1.1 Material

Zinc-coated steel conforming to ASTM A653/A653M, G90coating designation or aluminum-zinc alloy coated steel conforming to ASTM A792/A792M, AZ 55 coating. Minimum thickness to be 0.023 inch thick (24 gage) minimum.

2.1.2 Texture

Smooth with raised striations for added stiffness.

2.1.3 Finish

Factory color finish.

2.1.3.1 Factory Color Finish

Provide factory applied, thermally cured coating to exterior and interior of metal roof panels and metal accessories. Provide exterior finish top coat of fluoropolymer with not less than 0.8 mil dry film thickness. Provide exterior primer standard with panel manufacturer with not less than 0.2 mil dry film thickness. Interior finish shall consist of a 0.5 mil dry film thickness backer coat. Provide exterior and interior coating meeting test requirements specified below. Tests shall have been performed on the same factory finish and thickness provided.

2.2 INTERMEDIATE SUPPORTS

Fabricate panel subgirts, subpurlins, T-bars, Z-bars and tracks from galvanized steel conforming to ASTM A653/A653M, G90, Grade D (16 gage and heavier), Grade A (18 gage and lighter); or steel conforming to ASTM A36/A36M, ASTM A1011/A1011M , or ASTM A1008/A1008M prime painted with zinc-rich primer. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

2.3 ATTACHMENT CLIPS

Fabricate clips from ASTM A1011/A1011M, or ASTM A1008/A1008M steel hot-dip galvanized in accordance with ASTM A653/A653M, G 90, or Series 300 stainless steel. Size, shape, thickness and capacity as required to meet the load, insulation thickness and deflection criteria specified.

2.4 ACCESSORIES

Sheet metal flashings, gutters, downspouts, trim, moldings, closure strips, pre-formed crickets, caps, equipment curbs, and other similar sheet metal accessories used in conjunction with preformed metal panels shall be of the same material as used for the panels. Provide metal accessories with a factory color finish to match the roofing panels, except that such items which will be concealed after installation may be provided without the finish if they are stainless steel. Metal shall be of a thickness not less than that used for the panels. Thermal spacer blocks and other thermal barriers at concealed clip fasteners shall be as recommended by the manufacturer except that wood spacer blocks are not allowed.

2.4.1 Closures

2.4.1.1 Rib Closures

Corrosion resisting steel, closed-cell or solid-cell synthetic rubber, neoprene or polyvinyl chloride pre-molded to match configuration of rib opening. Material for closures shall not absorb water.

2.4.1.2 Ridge Closures

Metal-clad foam or metal closure with foam secondary closure matching panel configuration for installation on surface of roof panel between panel ribs at ridge and headwall roof panel flashing conditions and terminations. Foam material shall not absorb water.

2.4.2 Fasteners

Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Design the fastening system to withstand the design loads specified. Exposed fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

2.4.2.1 Screws

Not smaller than No. 14 diameter if self-tapping type and not smaller than No. 12 diameter if self-drilling and self-tapping.

2.4.2.2 Bolts

Not smaller than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.4.2.3 Automatic End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not smaller than 3/16 inch and cap or nut for holding covering against the shoulder.

2.4.2.4 Explosive Driven Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter

of not smaller than 0.145 inch with a shank length of not smaller than 1/2 inch for fastening to steel and not smaller than one inch for fastening to concrete.

2.4.2.5 Rivets

Blind rivets shall be stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

2.4.3 Sealants

Elastomeric type containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant shall be the non-hardening type. Seam sealant shall be factory-applied, non-skinning, non-drying, and shall conform to the roofing manufacturer's recommendations. Silicone-based sealants shall not be used in contact with finished metal panels and components unless approved otherwise by the Contracting Officer.

2.4.4 GASKETS AND INSULATING COMPOUNDS

Nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.5 UNDERLAYMENT

Self-adhering, high-temperture sheet, 30 to 40 mils thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer..

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces to receive standing seam metal roofing and flashing. Ensure that surfaces are plumb and true, clean, even, smooth, as dry and free from defects and projections which might affect the installation.

3.2 PROTECTION FROM CONTACT WITH DISSIMILAR MATERIALS

3.2.1 Cementitious Materials

Paint metal surfaces which will be in contact with mortar, concrete, or other masonry materials with one coat of alkali-resistant coating such as heavy-bodied bituminous paint.

3.2.2 Contact with Wood

Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

Install in accordance with the approved manufacturer's erection instructions, shop drawings, and diagrams. Panels shall be in full and firm contact with attachment clips. Where prefinished panels are cut in

the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they shall, after necessary repairs have been made with material of the same color as the weather coating, be approved before being installed. Seal completely openings through panels. Correct defects or errors in the materials. Replace materials which cannot be corrected in an approved manner with nondefective materials. Provide molded closure strips where indicated and where necessary to provide weathertight construction. Use shims as required to ensure attachment clip line is true. Use a spacing gage at each row of panels to ensure that panel width is not stretched or shortened. Apply underlayment as per the manufacturer's instructions.

3.3.1 Roof Panels

Apply roofing panels with the standing seams parallel to the slope of the roof. Provide roofing panels in longest practical lengths from ridge to eaves (top to eaves on shed roofs), with no transverse joints except at the junction of ventilators, curbs, and similar openings. Install flashing to assure positive water drainage away from roof penetrations. Locate panel end laps such that fasteners do not engage supports or otherwise restrain the longitudinal thermal movement of panels. Form field-formed seam type system seams in the field with an automatic mechanical seamer approved by the manufacturer. Attach panels to the structure with concealed clips incorporated into panel seams. Clip attachment shall allow roof to move independently of the structure, except at fixed points as indicated.

3.3.2 Insulation Installation

Insulation shall be installed between covering and metal decking to present a neat appearance.

3.3.3 Flashings

Provide flashing, related closures and accessories as indicated and as necessary to provide a weathertight installation. Install flashing to ensure positive water drainage away from roof penetrations. Flash and seal the roof at the ridge, eaves and rakes, and projections through the roof. Place closure strips, flashing, and sealing material in an approved manner that will assure complete weathertightness. Details of installation which are not indicated shall be in accordance with the SMACNA 1793, panel manufacturer's approved printed instructions and details, or the approved shop drawings. Allow for expansion and contraction of flashing.

3.3.4 Flashing Fasteners

Fastener spacings shall be in accordance with the panel manufacturer's recommendations and as necessary to withstand the design loads indicated. Install fasteners in roof valleys as recommended by the manufacturer of the panels. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay.

3.3.5 Rib and Ridge Closure/Closure Strips

Set closure/closure strips in joint sealant material and apply sealant to mating surfaces prior to adding panel.

3.4 PROTECTION OF APPLIED ROOFING

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of

smooth clean boards or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction.

3.5 CLEANING

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 shall be free of dents, creases, waves, scratch marks, solder or weld marks and damage to the finish coating.

3.6 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative shall visit the site as necessary during the installation process to assure panels, flashings, and other components are being installed in a satisfactory manner. Manufacturer's technical representative shall perform a field inspection during the first 20 squares of roof panel installation and at substantial completion prior to issuance of warranty, as a minimum, and as otherwise requested by the Contracting Officer. Additional inspections shall not exceed one for 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. Each inspection visit shall include a review of the entire installation to date. After each inspection, a report, signed by the manufacturer's technical representative, shall be submitted to the Contracting Officer noting the overall quality of work, deficiencies and any other concerns, and recommended corrective actions in detail. Notify Contracting Officer a minimum of 2 working days prior to site visit by manufacturer's technical representative.

3.7 COMPLETED WORK

Completed work shall be plumb and true without oil canning, dents, ripples, abrasion, rust, staining, or other damage detrimental to the performance or aesthetics of the completed roof assembly.

3.8 INFORMATION CARD

For each roof, provide a typewritten card, laminated in plastic and framed for interior display or a photoengraved 0.032 inch thick aluminum card for exterior display. Card to be 8 1/2 by 11 inches minimum and contain the information listed on Form 1 at end of this section. Install card near point of access to roof, or where indicated.

3.9 FORM ONE

FORM 1 - PREFORMED STEEL STANDING SEAM ROOFING SYSTEM COMPONENTS

1. Contract Number:

2. Building Number & Location:

3. Specification Number:

4. Deck/Substrate Type:

5. Slopes of Deck/Roof Structure:

6. Insulation Type & Thickness:

7. Insulation Manufacturer:

8. Vapor Retarder: ( )Yes ( )No

9. Vapor Retarder Type:

10. Preformed Steel Standing Seam Roofing Description:

a. Manufacturer (Name, Address, & Phone No.):
b. Product Name: c. Width: d. Gage:
e. Base Metal: f. Method of Attachment:

11. Repair of Color Coating:

a. Coating Manufacturer (Name, Address & Phone No.):
b. Product Name:
c. Surface Preparation:
d. Recoating Formula:
e. Application Method:

12. Statement of Compliance or Exception:_____
_____
_____

13. Date Roof Completed:

14. Warranty Period: From_____ To_____

15. Roofing Contractor (Name & Address):

16. Prime Contractor (Name & Address):

Contractor's Signature _____ Date:

Inspector's Signature _____ Date:

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS
01/07

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C1311	(2014) Standard Specification for Solvent Release Agents
ASTM C509	(2006; R 2011) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C734	(2006; R 2012) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C834	(2014) Latex Sealants
ASTM C919	(2012) Use of Sealants in Acoustical Applications
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1667	(2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D217	(2010) Cone Penetration of Lubricating Grease
ASTM D2452	(2003; R 2009) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D2453	(2003; R 2009) Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. 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.

1.5.3 Mock-Up

Project personnel is responsible for installing sealants in mock-up [prepared by other trades], using materials and techniques approved for use

on the project.

1.6 SPECIAL WARRANTY

Guarantee sealant joint against failure of sealant and against water penetration through each sealed joint for [five] [_____] years.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

Provide [ASTM C834] [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.	[As selected] [Gray] [White] [_____]
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	[_____]
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	[_____]
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	[_____]
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	[_____]
f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	[_____]
g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	[_____]
h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	[_____]
i. [_____]	[_____]

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] [As selected] [Gray] [White] [_____]
b. Joints between new and existing exterior masonry walls.	[_____]
c. Masonry joints where shelf angles occur.	[_____]
d. Joints in wash surfaces of stonework.	[_____]
e. Expansion and control joints.	[_____]
f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	[_____]
g. Voids where items pass through exterior walls.	[_____]
h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	[_____]
i. Metal-to-metal joints where sealant is indicated or specified.	[_____]
j. Joints between ends of gravel stops, fascias, copings, and adjacent walls.	[_____]
k. [_____]	[_____]

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.	[As selected] [Gray] [White] [_____]

LOCATION	COLOR
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	[_____]

2.1.4 Acoustical Sealant

[_____] Rubber or polymer-based acoustical sealant conforming to ASTM C919 must have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Acoustical sealant must have a consistency of 250 to 310 when tested in accordance with ASTM D217, and must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C734, and must be non-staining.

2.1.5 Preformed Sealant

Provide preformed sealant of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant must be non-bleeding and no loss of adhesion.

2.1.5.1 Tape

[_____] Tape sealant: Provide cross-section dimensions of [_____].

2.1.5.2 Bead

[_____] Bead sealant: Provide cross-section dimensions of [_____].

2.1.5.3 Foam Strip

Provide [_____] foam strip of polyurethane foam; with cross-section dimensions of [_____]. Provide foam strip capable of sealing out moisture, air, and dust when installed and compressed as recommended by the manufacturer. Service temperature must beminus 40 to plus 275 degrees F. Furnish untreated strips with adhesive to hold them in place. Do not allow adhesive to stain or bleed into adjacent finishes. Saturate treated strips with butylene waterproofing or impregnated with asphalt.

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material,

unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum [, [_____]] and other types of absorptive materials as backstops.

2.4.1 Rubber

Conform to ASTM D1056, [Type 1, open cell,] [or] [Type 2, closed cell,] Class [A] [B] [D], Grade [_____], [round] [_____] cross section for [_____] cellular rubber sponge backing.

2.4.2 PVC

Conform to ASTM D1667, Grade [VO 12] [_____], open-cell foam, [round] [_____] cross section for [_____] Polyvinyl chloride (PVC) backing.

2.4.3 Synthetic Rubber

Conform to ASTM C509, Option [I] [II], Type [I] [II] preformed [rods] [or] [tubes] for [_____] Synthetic rubber backing.

2.4.4 Neoprene

Conform to ASTM D1056, [closed cell expanded neoprene cord Type 2, Class C, Grade [2C2] [_____]] [open cell neoprene sponge Type 1, Class C, Grade [1C3] [_____]] for [_____] Neoprene backing.

2.4.5 Butyl Rubber Based

Provide Butyl Rubber Based Sealants of single component, solvent release, color [as selected] [_____], conforming to ASTM C1311.

2.4.6 Silicon Rubber Base

Provide Silicon Rubber Based Sealants of single component, solvent release, color [as selected] [_____], conforming to ASTM C920, Non-sag, Type [_____], Grade [_____], Class [25] [_____].

2.5 CAULKING

Conform to ASTM D2452 and ASTM D2453, Type [_____], for [_____] Oil- and resin-based caulking.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer [except for aluminum and bronze surfaces that will be in contact with sealant].

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing 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, masonry, stone, or [_____]:		
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

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
Over 2 inch	As recommended by sealant manufacturer	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES
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 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 C591	(2013) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate 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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	(2012) Standard Methods of Fire Tests of Door Assemblies
NFPA 80	(2013) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

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 A250.6	(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

UNDERWRITERS LABORATORIES (UL)

UL 10C	(2009) Standard for Positive Pressure Fire Tests of Door 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

Doors; G

Frames; G

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

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.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knock-down frames in bundles. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between

doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware 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. P

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 1, with core construction as required by the manufacturer for interior and exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation.

2.2 SOUND RATED STEEL DOORS

Doors shall have a Sound Transmission Class (STC) of 55.

2.3 ACCESSORIES

2.3.1 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors.

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

2.5 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 2, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners orknock-down field-assembled 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 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

2.5.3 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.

2.5.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

2.6 FIRE DOORS AND FRAMES

NFPA 80 and this specification. The requirements of NFPA 80 shall take precedence over details indicated or specified.

2.6.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10C. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.7 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.8 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 or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double

doors. Set lock strikes out to provide clearance for silencers.

2.9 FINISHES

2.9.1 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. Where coating is removed by welding, apply touchup of factory primer.

2.9.2 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.

2.10 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.

2.10.1 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.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80.

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 14 00

WOOD DOORS
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 in the text by the basic designation only.

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI AWS (2009) Architectural Woodwork Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2013) Standard for Fire Doors and Other Opening Protectives

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

ANSI/WDMA I.S.1A (2013) Interior Architectural Wood Flush Doors

WDMA TM-7 (2008) Cycle Slam Test Method

WDMA TM-8 (2008) Hinge Loading Test Method

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

Submit drawings or catalog data showing each type of door unit. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly,.

SD-03 Product Data

Doors; G

SD-06 Test Reports

Cycle-slam

Hinge loading resistance

Submit cycle-slam test report for doors tested in accordance with

WDMA TM-7, and hinge loading resistance test report for doors tested in accordance with WDMA TM-8.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inch thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Replace defective or damaged doors with new ones.

1.4 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs indicatedfree of urea-formaldehyde resins.

2.1.1 Flush Doors

Conform to ANSI/WDMA I.S.1A for flush doors. Hardwood stile edge bands of doors receives a natural finish, compatible with face veneer. No visible finger joints will be accepted in stile edge bands.

2.1.1.1 Interior Flush Doors

Provide solid core, Type II flush doors conforming to ANSI/WDMA I.S.1A with faces of premiumgrade red oak. Hardwood veneers shall be plain sliced.

2.2 FABRICATION

2.2.1 Marking

Stamp each door with a brand, stamp, or other identifying mark indicating quality and construction of the door.

2.2.2 Quality and Construction

Identify the standard on which the construction of the door was based.

2.2.3 Adhesives and Bonds

ANSI/WDMA I.S.1A. Use Type II bond for interior doors. Provide a nonstaining adhesive on doors with a natural finish.

2.2.4 Prefitting (Option)

Provide factory prefitted doors for the specified hardware, door frame and door-swing indicated. Machine and size doors at the factory by the door manufacturer in accordance with the standards under which the doors are produced and manufactured. The work includes sizing, beveling edges,

mortising, and drilling for hardware. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules to coordinate the work.

2.2.5 Finishes

2.2.5.1 Field Painting

Provide natural finish polyurethane as per Section 09 90 00 Paints and Coatings..

2.2.5.2 Factory Finish (Option)

Provide doors finished at the factory by the door manufacturer as follows: AWI AWS Section 1500, specification for System No. 4 Conversion varnish alkyd urea or System No. 5 Vinyl catalyzed. The coating is AWI AWS premium, medium rubbed sheen, closed grain effect. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

PART 3 EXECUTION

3.1 INSTALLATION

Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/8 inch minimum, 7/16 inch maximum clearance at bottom . Bevel edges of doors at the rate of 1/8 inch in 2 inch. Door warp shall not exceed 1/4 inch when measured in accordance with ANSI/WDMA I.S.1A.

3.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Do not paint over labels.

-- End of Section --

SECTION 08 33 23

OVERHEAD COILING DOORS
07/07

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP	(2013) Fundamentals Handbook, I-P Edition

ASME INTERNATIONAL (ASME)

ASME B29.400	(2001; R 2013) Combination, "H" Type Mill Chains, and Sprockets

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A27/A27M	(2013) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A307	(2012) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	(2012) Standard Specification for Carbon Structural Steel
ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
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 A924/A924M	(2013) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D2000	(2012) Standard Classification System for Rubber Products in Automotive Applications
ASTM E330	(2002; R 2010) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

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

Overhead Coiling Doors; G

Counterbalancing Mechanism; G

Manual Door Operators; G

Bottom Bars; G

Guides; G

Mounting Brackets; G

Overhead Drum; G

Hood; G

Installation Drawings; G

SD-03 Product Data

Overhead Coiling Doors; G

Hardware; G

Counterbalancing Mechanism; G

Manual Door Operators; G

SD-05 Design Data

Overhead Coiling Doors; G

Hardware; G

Counterbalancing Mechanism; G

Manual Door Operators; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Materials; G

Devices; G

Procedures; G

Manufacture's Brochures; G

Parts Lists; G

Cleaning; G

1.3 OVERHEAD COILING DOOR DETAIL SHOP DRAWINGS

Provide installation drawings for overhead coiling door assemblies which show: elevations of each door type, shape and thickness of materials, finishes, details of joints and connections, details of guides and fittings, rough opening dimensions, location and description of hardware, anchorage locations, and counterbalancing mechanism and door operator details. Include a schedule showing the location of each door with the drawings.

1.4 WARRANTY, OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:

Materials

Devices

Manual Door Operators

Counterbalancing Mechanism

Procedures

Manufacture's Brochures

Parts Lists

Furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship for not less than two years after completion and acceptance of the project.

Warrant that upon notification by the Government, any defects in material, workmanship, and door operation are immediately correct within the same time period covered by the guarantee, at no cost to the Government.

1.5 DELIVERY AND STORAGE

Deliver doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in an adequately ventilated dry location that is free from dirt and dust, water, or other contaminants. Store in a manner that permits easy access for inspection and handling.

PART 2 PRODUCTS

2.1 DESCRIPTION

Doors to be coiling type, with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated. Use grease-sealed or self-lubricating bearings for rotating members.

2.2 PERFORMANCE REQUIREMENTS

2.2.1 Wind Loading

Design and fabricate door assembly to withstand the wind loading pressure of at least 20 pounds per square foot with a maximum deflection of 1/120 of the opening width. Provide test data showing compliance with ASTM E330. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested. Ensure complete assembly meets or exceeds the requirements of ASCE 7.

2.2.2 Operational Cycle Life

Design all portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

2.3 OVERHEAD COILING DOORS

2.3.1 Curtain Materials and Construction

Provide curtain slats fabricated from Grade A steel sheets conforming to ASTM A653/A653M, with the additional requirement of a minimum yield point of 33,000 psi. Provide sheets, galvanized in accordance with ASTM A653/A653M and ASTM A924/A924M.

Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Ensure the

provided slats are continuous without splices for the width of the door.

Provide slats filled with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within slat faces on interior surface of slats.

2.3.2 Non-Insulated Curtains

Form Curtains from manufacturer's standard shapes of interlocking slats.

2.3.3 Insulated Curtains

Form Curtains from manufacturer's standard shapes of interlocking slats. Supply slat system with a minimum R-value of 8 when calculated in accordance with ASHRAE FUN IP. Slats to consist of a urethane or polystyrene core not less than 11/16 inch thick, completely enclosed within metal facings. Ensure the exterior face of slats are the same gauge as specified for curtains. Select an interior face not lighter than 0.0219 inches. The insulated slat assembly requires a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E84.

2.3.4 Curtain Bottom Bar

Install curtain bottom bars as pairs of angles from the manufacturer's standard steel, not less than 2.0 by 2.0 inches by 0.188 inch. Ensure steel extrusions conform to ASTM A36/A36M. Galvanize angles and fasteners in accordance with ASTM A653/A653M and ASTM A924/A924M. Coat welds and abrasions with paint conforming to ASTM A780/A780M.

2.3.5 Locks

Provide end and/or wind locks of Grade B cast steel conforming to ASTM A27/A27M, galvanized in accordance with ASTM A653/A653M, ASTM A153/A153M and ASTM A924/A924M. Secure locks at every other curtain slat.

2.3.6 Weather Stripping

Ensure weather-stripping at the door-head and jamb is 1/8-inch thick sheet of natural or neoprene rubber with air baffles. Secure weather stripping to the insides of hoods with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 5/8-inch wide and 1/8-inch thick.

Ensure threshold weather-stripping is 1/8-inch thick sheet natural or neoprene rubber secured to the bottom bars.

Provide weather-stripping of natural or neoprene rubber conforming to ASTM D2000.

2.3.7 Locking Devices

Ensure slide bolt engages through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

Provide a locking device assembly which includes cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

2.3.8 Overhead Drum

Fabricate drums from nominal 0.028-inch thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.

2.3.9 Slats

No. 5F, 22 gauge, Grade 40 steel, ASTM A653/A653M galvanized steel zinc coating.

]2.4 HARDWARE

Ensure all hardware conforms to ASTM A153/A153M, ASTM A307, ASTM F568M, and ASTM A27/A27M.

2.4.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated. Provide guides with sufficient depth and strength to retain curtain, and to withstand loading. Ensure curtain operates smoothly. Slot bolt holes for track adjustment.

2.4.2 Equipment Supports

Fabricate door-operating equipment supports from the manufacturer's standard steel shapes and plates conforming to ASTM A36/A36M, galvanized in accordance with ASTM A653/A653M and ASTM A924/A924M. Size the shapes and plates in accordance with the industry standards for the size, weight, and type of door installation.

2.4.3 Hood

Provide a hood with a minimum 24-gaugegalvanized sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness. The hood encloses the curtain coil and counterbalance mechanism.

2.5 COUNTERBALANCING MECHANISM

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted, around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

2.5.1 Brackets

Provide the manufacturer's standard mounting brackets with one located at each end of the counterbalance barrel conforming to ASTM A48/A48M. Provide brackets of either cast iron or cold-rolled steel.

2.5.2 Counterbalance Barrels

Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, conforming to ASTM A53/A53M. Ensure the barrel is of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats. Limit barrel deflection to not more than 0.03 inch per foot of span under full

load.

2.5.3 Spring Balance

Install one or more oil-tempered, heat-treated steel helical torsion springs within the barrel, capable of producing sufficient torque to assure easy operation of the door curtain. Provide and size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

2.5.4 Torsion Rod for Counter Balance

Fabricate rod from the manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

2.6 MANUAL DOOR OPERATORS

2.6.1 Manual Chain-Hoist Door Operators

Provide door operators which consist of an endless steel hand chain, chain-pocket wheel, guard, and a geared reduction unit of at least a 3 to 1 ratio with a maximum lifting force of 25 lbf. Required pull for operation cannot exceed 35 pounds.

Provide chain hoists with a self-locking mechanism allowing the curtain to be stopped at any point in its upward or downward travel and to remain in that position until moved to the fully open or closed position. Provide hand chains of cadmium-plated alloy steel conforming to ASME B29.400. Ensure yield point of the chain is at least three times the required hand-chain pull.

Provide chain sprocket wheels of cast iron conforming to ASTM A48/A48M.

2.7 SURFACE FINISHING

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Noticeable variations in the same metal component are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 GENERAL

Install overhead coiling door assembly, anchors and inserts for guides, brackets, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, ensure doors are free from all distortion.

Install overhead coiling doors, hoods, and operators at the mounting locations as indicated for each door in the contract documents and as required by the manufacturer.

Install overhead coiling doors along accessible routes in compliance with regulatory requirements for accessibility and as required by the manufacturer.

3.2 FIELD PAINTED FINISH

Ensure field painted steel doors and frames are in accordance with Section 09 90 00 PAINTS AND COATINGS and manufacturer's written instructions. Protect weather stripping from paint. Ensure finishes are free of scratches or other blemishes.

3.3 ACCEPTANCE PROVISIONS

After installation, adjust hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to manufacturer's written instructions.

Test and make final adjustment of new doors at no additional cost to the Government.

3.3.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, examine, lubricate, test, and re-adjust doors as required for proper operation.

3.3.2 CLEANING

Clean doors in accordance with manufacturer's approved instructions.

3.4 OPERATION AND MAINTENANCE

Submit 3 copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the Overhead Coiling Door Assemblies. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

Provide operation and maintenance manuals which are consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Provide test data that is legible and of good quality.

-- End of Section --

SECTION 08 34 16.20

VERTICAL LIFT FABRIC DOORS
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.

ALUMINUM ASSOCIATION (AA)

AA ADM	(2010) Aluminum Design Manual
AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604	(2010) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 611	(1998; R 2004) Voluntary Specification for Anodized Architectural Aluminum

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2011) Steel Construction Manual
AISC 360	(2010) Specification for Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS A5.10/A5.10M	(2012) Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys - Classification
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 A1023/A1023M	(2009; E 2012) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
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 A992/A992M	(2011) Standard Specification for Structural Steel Shapes
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 D2136	(2002; R 2012) Coated Fabrics - Low-Temperature Bend Test
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60034-1	(2010) Rotating Electrical Machines - Part 1: Rating and Performance
IEC 60034-14	(2007) Rotating Electrical Machines - Part 14: Mechanical Vibration of Certain Machines with Shaft Heights 56 mm and Higher - Measurement, Evaluation and Limits of Vibration Severity
IEC 60034-5	(2006) Rotating Electrical Machines - Part 5: Degrees of Protection Provided by the Integral Design of Rotating Electrical Machines (IP Code) - Classification
IEC 60034-6	(1991) Rotating Electrical Machines Part 6: Methods of Cooling (IC Code)
IEC 60204-1	(2009) Safety of Machinery - Electrical Equipment of Machines - Part 1: General Requirements
IEC 60269-1	(2014) Low-Voltage Fuses - Part 1: General Requirements
IEC 60269-2	(2013) Low-Voltage Fuses - Part 2: Supplementary Requirements for Fuses for Use by Authorized Persons (Fuses Mainly for Industrial Application) - Examples of Standardized Systems of Fuses A to K
IEC 60364-1	(2005) Low-voltage Electrical

	Installations in Buildings - Part 1: Fundamental Principles, Assessment of General Characteristics, Definitions
IEC 60364-5	(2009) Low-Voltage Electrical Installations - Part 5-52: Selection and Erection of Electrical Equipment - Wiring Systems
IEC 60947-1	(2011) Low-Voltage Switchgear and Controlgear - Part 1: General Rules
IEC 60947-2	(2013) Low-Voltage Switchgear and Controlgear - Part 2: Circuit-Breakers
IEC 60947-3	(2012; AMD 1; CORR 1) Low-Voltage Switchgear and Controlgear - Part 3: Switches, Disconnectors, Switch-Disconnectors and Fuse-Combination Units
IEC 60947-4-1	(2012; ED 3.1) Low-voltage Switchgear and Controlgear, Part 4-1: Contactors and Motor Starters - Electromechanical Contactor and Motor Starters

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA ICS 1	(2000; R 2008; E 2010) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 5	(2000; R 2010) Control Circuit and Pilot Devices
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA MG 1	(2011; Errata 2012) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2012; Amendment 1 2012) Life Safety Code

NFPA 220	(2015) Standard on Types of Building Construction
NFPA 409	(2011; Errata 11-1) Standard on Aircraft Hangars
NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3 2014) National Electrical Code
NFPA 79	(2015) Electrical Standard for Industrial Machinery

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-200-01	(2013) General Building Requirements
UFC 3-301-01	(2013) Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL 1449	(2014) Surge Protective Devices
UL 248-1	(2011) Low Voltage Fuses - Part 1: General Requirements
UL 248-12	(2011) Low Voltage Fuses - Part 12: Class R Fuses
UL 489	(2013; Reprint Mar 2014) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment
UL 98	(2004; Reprint May 2012) Enclosed and Dead-Front Switches

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00.

SD-01 Preconstruction Submittals

Manufacturer's Qualifications[; G][; G, [_____]]

Installer's Qualifications[; G][; G, [_____]]

SD-02 Shop Drawings specific to this project, sealed by the Door Manufacturer's Registered Professional Engineer

Shop drawings of motors, all electrical control devices, and all

electrical control panels, including schematic diagrams, dimensional drawings of control panels, details of control panel installations, internal wiring diagrams of control panels, and wiring diagrams indicating all external connections between control panels and from control panels to remote control devices. Furnish list of materials for all control devices, both inside and remote from control panels including manufacturer's model number, electrical ratings, location, and quantity of each item furnished.

Door Design[; G][; G, [_____]]

Show all vertical lift fabric doors and components, including types, sizes, locations, fabric, supporting, bracing and framing steel and aluminum members, metal gages, fasteners, speed, hardware provisions, signage, installation details, and other details of construction. Include supporting brackets for motors, location of motors, and safety devices. Include personnel door, mullion pit and cover or retractable pin and strike if utilized. Provide details for the closure between bulkhead and doors. Include details for supporting and bracing the door assembly from the structure. Indicate finishes to be used.

SD-03 Product Data

Diagrams, performance curves and characteristic curves of equipment and systems.

Electric Operator[; G][; G, [_____]]

Drive unit system horsepowers, belt type, and locations. Safety arrestor type, test reports, and brake system details.

Motors[; G][; G, [_____]]

Motor characteristics including horsepower, service factor, safety factor and standards compliance.

Doors[; G][; G, [_____]]

Controls[; G][; G, [_____]]

Controls characteristics including all electrical components and devices used in the control system, enclosures, safety devices, transformer size and voltage, and emergency power connection.

Door Fabric[; G][; G, [_____]]

Submit fabric panel samples for weight, strength and color approval.

Surge Protection Device (SPD) data for each incoming/outgoing power feeder and each control circuit[; G] [; G, [_____]]

SD-05 Design Data

Calculations sealed by the Door Manufacturer's Registered Professional Engineer[; G][; G, [_____]]

Door Load Diagrams (Open/Closed positions)[; G][; G, [_____]]

SD-06 Test Reports

Safety Arrester Operation Test[; G][; G, [_____]]

Door Fabric: ASTM D2136[; G][; G, [_____]]

Door Fabric: ASTM E84[; G][; G, [_____]]

SD-07 Certificates

Manufacturer's Qualifications[; G][; G, [_____]]

Installers Qualifications[; G][; G, [_____]]

Welding Procedures and Qualifications[; G][; G, [_____]]

SD-09 Manufacturer's Field Reports

Acceptance Testing Procedure and Report[; G][; G, [_____]]

SD-10 Operation and Maintenance Data

Door Operation, Data Package 2[; G][; G, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Including wiring diagrams and the complete manufacturer's instructions for operation and maintenance of the doors, door mullions where indicated, and accessories, including emergency operation, in the event of general building power failure to the doors.

Emergency and Routine Preventative Maintenance Plan[; G][; G, [_____]]

SD-11 Closeout Submittals

Acceptance Testing Procedure and Report[; G][; G, [_____]]

Manufacturer's Warranty[; G][; G, [_____]]

1.3 DESIGN REQUIREMENTS

1.3.1 Door Design and Components

The vertical lift fabric doors and components indicated in the construction documents are representative of a commercially-available door. Design and fabricate the door to fit within the space allocated and in accordance with the criteria specified herein. Door must operate properly without binding, interference, or damage to the adjacent structure. Door must be of limited combustible construction in accordance with NFPA 220 and NFPA 409.

1.3.1.1 Steel Door Components

All supporting, bracing and framing steel members must be designed by the door manufacturer's registered professional engineer for the specified loads according to the requirements of AISC 325 and AISC 360. Steel welding must be in accordance with the AWS D1.1/D1.1M Standards. Refer to Section 05 12 00 STRUCTURAL STEEL for requirements.

1.3.1.2 Aluminum Door Components

All supporting, bracing and framing aluminum members must be designed by the door manufacturer's registered professional engineer for the specified loads according to the requirements of the Aluminum Association (AA ADM). Aluminum welding must be in accordance with AWS D1.2/D1.2M standards.

1.3.2 Loads

The loads for the design of the door must be in accordance with UFC 1-200-01, UFC 3-301-01 and all other applicable criteria.

1.3.2.1 Wind Loads

In the closed position, doors and all components must be designed to withstand the wind pressures as indicated by the Engineer of Record. All door components must be designed to withstand both the highest positive and negative pressures based on actual tributary area from the wind load indicated.

In addition, doors and all components must be designed to be operational during wind events which cause a positive or negative service load pressure of 15 psf on the surface of the door. Also the door mullions where indicated and jambs must be designed for an unbalanced positive or negative service load pressure of 15 psf load on the surface of a closed adjacent door with the other adjacent door being open.

Calculations sealed by the door manufacturer's registered professional engineer must be submitted for review.

1.3.2.2 Other Loads

The door mullions where indicated must be of adequate strength to transmit the forces from design wind load, in addition to the other loads resulting from door operations or the door's action as a tributary element, with no detrimental effect on the operation of the door. The door manufacturer must submit the loads imposed upon the building structure by the vertical lift fabric door and its components.

1.3.3 Door Speed

Door must open fully at a speed of 6 inches per second minimum under all design conditions. The door mullion when required must rotate with a cable retraction speed of 6 inches per second minimum.

1.3.4 Door Weight

The door manufacturer must provide load diagrams of the door in the closed and open positions. Details must also be provided showing clearance and attachment requirements for coordination with the structural steel and miscellaneous steel shop drawings.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

Use a vertical lift fabric door product from a manufacturer who is regularly engaged in the design, fabrication, erection, and service of

vertical lift fabric doors of type and size required for this project. The manufacturer must have at least 5 years of similar vertical lift fabric door design experience. Similar doors must have comparable function and design including size, configuration, type of use, retractable or moving elements, safety features, controls, and other key engineering elements as the door being specified. It is acceptable to show that a series of similar doors collectively meet all comparable elements to the door being specified, although not necessarily individually. Manufacturer must submit written evidence on similar past door designs and installations listing the name, location, contact information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation. Only manufacturers who can submit this evidence of actual installations where the products have proven practical, durable, and require a minimum of maintenance, will be qualified under this specification.

1.4.2 Installer's Qualifications

Installation of the door(s) must be supervised by a manufacturer's representative and must be in accordance with approved shop drawings. Installers must be skilled and experienced in the erection of vertical lift fabric doors of the type specified herein. Installers must submit written evidence of similar past door installations listing the name, locations, contacts information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation.

1.4.3 Warranty

The door manufacturer must provide a three-year warranty for all mechanical and electrical components against defects in material and workmanship beginning on the date of Project Acceptance. The warranty for fabric must be ten years against defect in material.

1.4.3.1 Maintenance and Repair Action Plan

The door manufacturer must provide an Emergency and Routine Preventative Maintenance Plan. In addition to Data Package SD-10 "Operation and Maintenance Data", provide a list of phone numbers and personnel contacts. Also provide a list of suggested spare parts materials and tools to be purchased by the Contracting Officer. Submit vertical lift fabric door manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4.4 Delivery, Storage and Handling

The door manufacturer must provide shipment of all materials required for door installation in protective packaging. Protect door and accessories from damage during delivery, storage, and handling. Mark all packaging clearly with manufacturer's brand name, door model and job site location. Store in dry location with adequate ventilation, and free from dust and water. Storage must permit easy access for inspection and handling. Remove damaged items that cannot be restored to like new condition or provide new items.

1.5 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.

Comply with applicable provisions of AWS D1.1/D1.1M for Steel.

Comply with applicable provisions of AWS D1.2/D1.2M for Aluminum.

PART 2 PRODUCTS

2.1 MATERIALS

Materials must be selected based on durability, low maintenance, weather resistance and strength (permanent deformation from loading not allowed). Doors must comply with ASTM E84 for limited combustible construction.

2.1.1 Steel Plate and Bars

ASTM A36/A36M

2.1.2 Steel Sheet

ASTM A653/A653M

2.1.3 Steel Shapes

ASTM A992/A992M

2.1.4 Aluminum Extrusions

ASTM B221, Alloy 6063-T6, Alloy 6005-T5 or 6000 Series Aluminum

2.1.5 Aluminum Sheets and Strips

ASTM B209, alloy and temper best suited for the purpose.

2.1.6 Aluminum Welding Rods and Bare Electrodes

AWS A5.10/A5.10M.

2.1.7 Door Fabric

The fabric material must be a one piece heavy-duty vinyl coated polyester fabric weighing not less than 19 oz/square yard, capable of carrying 250 lb/in per panel. Fabric must be impervious and resistant to solvents, fuel, lubricants and other similar fluids commonly found in aircraft maintenance hangars. It must be UV stabilized, self-extinguishing (0-75 flame spread), and suitable to withstand temperatures between plus 158 to minus 31 degrees F in compliance with ASTM D2136. [Use a translucent material in approximately the top 10 feet of the door to allow day-lighting of the hangar high bay area. The translucent material must also meet the same requirements and loadings as the standard door fabric.] Fabric color must be as selected by the Government from the manufacturer's standard colors. The door fabric must be pulled tight between the intermediate beams when the door is fully closed and the wind locks engaged. The fabric must have been tested to meet the criteria of ASTM E84-94 (flame spread - Class A interior wall and ceiling finish) and ASTM D2136 (cold cracking, brittleness and temperature).

2.1.8 Steel Cable and Wire Rope

ASTM A1023/A1023M.

2.2 DOORS

Doors must consist of hoist up fabric doors with intermediate aluminum beams or trusses. Fabric must be gathered above the head of the opening. Maximum wind load deflection of steel structural members of the door must not exceed the member length divided by 120. Maximum wind load deflection of extruded aluminum members of the door must not exceed the member length divided by 30.

2.2.1 Fabric Door Panels

The fabric must be attached to both sides of the intermediate beams, top beam, and bottom beam with self-tapping screws through corrosion resistant anodized or coated aluminum batten strips. Provide batten strip covers of PVC material to snap over the aluminum batten strips and be full width of the door fabric. Coated aluminum batten strips and PVC batten strip covers must be selected from the manufacturer's standard colors, which must offer a variety of options including colors to match the Standard Door Fabric color.

2.2.2 Door Beams

The intermediate beams must be corrosion resistant, extruded aluminum and have a suitable depth dependent on the door width and the wind load requirements. They must be spaced 35 to 75 inches apart, dependent upon the wind load. At each end of the beams there must be a guide block of self-lubricating material or rollers that run along the guides. Built-up members meeting these requirements are acceptable. The intermediate door beams and guide block or rollers must be designed to carry the full design wind load without failure and being pulled from the door guides. The guide block or roller design must not put the intermediate beam into tension which would cause pulling forces on door jambs. Guide block material must be nylon, polyoxymethylene (POM), or Ultra High Molecular Weight (UHMW) polyethylene. Rollers must be galvanized steel with maintenance free, lifetime sealed ball-bearings in case-hardened steel races.

2.2.3 Door Guides

The vertical guides must be an integral part of the door, made of extruded aluminum with a suitable depth and width dependent on the size of the intermediate beams and wind load requirements. The guides must be designed to provide weather sealing on the inside and outside faces. There must also be a space inside the guides for the nylon belt, polyester belt, or steel cable of the drive unit and safety arresters. The installer must provide jamb anchorage of size and type required for attachment of the guide rails as shown on the approved shop drawings. The jamb anchorage and door guides must be designed to carry the full design wind load without failure and without permanent deformation.

2.3 ELECTRIC OPERATORS

2.3.1 Drive Units

Each door leaf must have a single or dual motor drive system with horsepower sized as appropriate for the weight of the door leaf. The gear

motor must be equipped with a drum on which the nylon belt, polyester belt, or steel cables are wound. If a single motor drive is used, the belts and cables must be wound on the same drum. Cables must be wound on a grooved drum. The belts and cables must be attached to the bottom beam via the safety arresters. A hand crank device or other manual means must be provided on the motor for manual operation of the door in the event of a power failure. The gear motor must be removable without disturbing limit switch adjustment. The drive units will be coordinated with the location of aircraft such that the drive units are accessible while aircraft are in the hangar.

2.3.2 Belt/Cable System

A maximum of two belts/cables per door, running inside the door guides, must be used to transmit motive force to the door unit. Similarly, the quantity of sheaves used to guide the belts/cables must be minimized to reduce maintenance requirements and spare parts inventories. Belts/cables must be installed free of any kinks and the system design and sheave diameter must be such to prevent the occurrence of any kinks and abnormal stress in the operating belts/cables. Where belts/cables pass through openings of the building structure, the openings must be constructed so as to prevent abrasion, wear, or damage to the belts and cables. Sheave units must be provided in accessible locations that allow inspection and preventive maintenance. Sheaves must not be located in enclosed locations, which are not readily accessible for visual inspection.

2.3.3 Safety Arresters

Each door leaf must be supplied with two safety arresters that automatically activate and support the door in case the door lifting system fails similar to a belt or cable breaking. A "Safety Arrestor Operation Test" must be performed on each set of safety arresters by an independent testing source to withstand at least 110 percent of the maximum door leaf weight.

The "Safety Arrestor Operation Test" must be deemed successful when it contains at least the minimum following criteria:

a. Test door weight must be at least 110 percent of the specific project's door weight.

b. Test must simulate the door lifting system abruptly disengaging similar to a belt or cable breaking.

c. The Safety Arresters must automatically engage.

d. The test door weight must be brought to rest after an initial downward movement (or drop) of not more than 12 inches and held firmly in this position.

e. Damage from activation of the Safety Arrestors must be limited to localized replaceable components and not cause a system failure which would require repair or replacement of the entire VLFD or the structural door jambs.

f. Independent testing source must submit documentation of successful " Safety Arrester Operation Test".

The moveable mullions, when provided, must be provided with a lifting motor

that includes a backup arresting system or secondary brake system to prevent the mullion form falling in case of motor or primary brake failure.

2.3.4 Slack Belt/Cable Breaker

A safety device must be used on all door leaf belts/cables that will send a slack belt/cable condition and cut power to the appropriate drive unit to prevent an unsafe condition.

2.3.5 Motors

[NEMA MG 1][or][IEC 60034-1, IEC 60034-5, IEC 60034-6, IEC 60034-14], high-starting torque, reversible type with sufficient horsepower and torque output to move the door in either direction from any position. Motor must produce a door travel speed of not less than 6 inches per second without exceeding the rated capacity. Motors must operate on voltage of the characteristics indicated at not more than 1800 rpm. Motor enclosures must be drip-proof type or NEMA totally-enclosed, fan-cooled (TEFC) type. A hand crank must be supplied which fits the motor for manual operation of the door in the event of a power failure. Install motors in approved locations. Motors must have a minimum service factor of 1.2 at continuous duty under maximum full load. The design of the door motor and door drive gear box must each have a safety factor of 2.5. Motors must be provided in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and requirement listed above.

2.3.6 Controls

Control equipment must conform to [NEMA ICS 2][or][IEC]. Control enclosures must be NEMA ICS 6, Type 12 or Type 4X. [The door electrical controls must comply with IEC standards IEC 60204-1, IEC 60269-1, IEC 60269-2, IEC 60364-1, IEC 60364-5, IEC 60947-1, IEC 60947-2, IEC 60947-3, and IEC 60947-4-1.][The door electrical controls must comply with NEMA AB 1, NEMA ICS 2, NEMA ICS 5, and NEMA KS 1. The door electrical controls must comply with NEMA ICS 1, NEMA ICS 6, NFPA 70, NFPA 79, UL 98, UL 248-1, UL 248-12, UL 489, UL 508, and UL 1449.] The door control components must all be UL listed.

Each Door Module must be provided with the following operators:

Master Control Panel (NEMA Type 4X or NEMA Type 12 enclosure)

a. Remote Push Button Station - at opposite end of hangar door (NEMA Type 4X enclosure).

b. Emergency Stop Buttons located outside at the end of each hangar bay (NEMA Type 4X enclosure).

c. "Open" operator located on the exterior of each bay door keyed for use by Fire Department personnel to allow entry in the event of an emergency (NEMA Type 4X enclosure).

The door supplier must provide all conduit and control wiring between master, slave, emergency stop controls, proximity switches, limit switches, and each door motor drive unit. Power and controls wiring and conduit must be provided in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.3.6.1 Control Panel Enclosures

Control panel enclosures must be NEMA ICS 6, Type 12 or Type 4X. Each control panel must have an integral main power disconnect switch that is mechanically interlocked with the control panel door. Provide factory wired field wiring terminal strip in each control panel and instantaneous three-phase thermal overload relays. Provide each control panel enclosure including an internal motor starter or VFD with adequate integral ventilation (air conditioning if required) for operation in a 120 degree F ambient environment. Provide [NEMA][or][IEC] rated control relays. Provide main control panel with [relay logic][programmable logic controller].

Provide a three phase UL 1449 listed surge protection device (SPD) for the incoming power to each door control panel. Provide a UL 1449 listed surge suppression device (SPD) for each control circuit (limit switch, proximity switch, motor, brake, solenoid, indicating light, and pushbutton) that is routed external from each door main control panel.

The control panel must contain devices to control the logic and sequence of door and mullion operation to ensure safe operation. The control panel must also contain interlocks to preclude personnel injury, including an interlock between the power supply system and use of the hand crank for manual operation of the door. Constant-pressure type, fully guarded, illuminated push buttons must be provided on the control panel for both up and down operations. Mushroom type emergency stop button must be provided on each control panel. [Touch screen user interfaces will be used on multiple leaf hangar doors. Desired door or mullion motion will be selected via the touch screen. Door motion will be initiated via fully guarded push buttons.]

Back-up power hook up must be provided at the control panel to connect to [a building backup power generator with automatic transfer switch] [a portable generator provided by the Base via a pin and sleeve female receptacle (coordinate with Base) and manual transfer switch provided on the main control panel].

2.3.7 Limit Switches

Provide limit switches or proximity switches to automatically stop doors [and mullions] at the fully open and fully closed positions. Limit switches or proximity switch positions must be readily adjustable. Limit switches or proximity switches for the wind lock must be provided with indicator lights installed on the control panel for each door leaf. The indicator must notify the door operator that the wind locks are engaged for all door leaves.

[Provide each retractable mullion pin with a limit switch or proximity switch interlock that proves that the mullion pin (whether electric or manual) is fully extended and locked before the door can be moved. If the limit switch or proximity switch is located below 18 inches above the hangar floor, it must be either rated Class I Division 2 explosion-proof or the circuit must be intrinsically safe rated for a Class I Division 2 hazardous location.

] The door installer must demonstrate the operability of all limit switches prior to Government occupancy.

2.3.8 Door Control Alarms

Provide an audible alarm device on each door main control panel (minimum 100 dbA) that sounds 10 seconds before the door moves and continues to sound when the door is moving. Coordinate this audible signal such that it is clearly different from all of the other audible signals utilized in the hangar bay.

Provide a visual alarm device above each door main control panel (rotating beacon with 100 watt halogen lamp) that operates 10 seconds before the door moves and continues to operate when the door is moving. Coordinate the color of this visual signal such that it is clearly a different color than all of the other visual signals utilized in the hangar bay.

2.3.9 Safety Device

Provide an intrinsically safe (suitable for a Class I Division 2 hazardous location) electric safety edge on the bottom of the edge of each door, continuous over the full length of the door. The safety edge must be located inside of a rubber cushioned bottom weather sealing edge (or boot) with sufficient vertical height (factoring in the time and distance that it takes to stop a closing door) that must prevent collision damage along the bottom edge of the door. The safety edge must be active when the door is closing, except it must be automatically de-activated the last (door length in inches/240) to allow for the L/240 deflection of the bottom beam which would prevent the door from stopping when only the middle of the door bottom beam (sagging with deflection) strikes the hangar floor before the ends of the door bottom beam reach the hangar floor, thus allowing the door to completely close along its entire length.

2.3.10 Control Transformers

Provide fused transformers inside of each Master Control Panel as necessary to reduce the voltage on the control circuits to 120 volts or less.

2.3.11 Electrical Components

NFPA 70. The door manufacturer must provide automatic control and safety devices, including failsafe battery powered wireless limit switches or hard-wired limit switches for mandoor interlocks. Cable reel type take-up devices must not be allowed. Control wiring must be in accordance with NFPA 70. The door supplier must provide conduit, wiring, and mounting of controls in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

[2.3.12 User Interface with Diagnostics

The door manufacturer must supply a human machine interface (HMI) on the face of the Main Control Panel for multiple doors. The function of the diagnostic panel is to provide information on the status of electrical components in the door system. The HMI must consist of a large (8-10 inch diagonal measure) touch screen including a graphical representation of the door system to facility ease of use. The HMI must provide current door status including windlocks when applicable. A self diagnostic system must be included to provide detailed status information of a malfunction and provide guided trouble shooting and diagnostic features. The HMI must also provide a log for malfunctions and system alarms as well as provide detailed service monitoring and service history. Operation and configuration of the system must be controlled by multi-level password access to limit access to the system to qualified and authorized users.

The HMI must include functionality for remote access to the system, by the manufacturer via both internet and cellular modem, to review malfunction logs, update settings, or assist in troubleshooting, should the user choose to allow such access.

]2.4 HEADER BOX

Header boxes must be constructed of carbon steel and finished per the Section entitled, "Finishes".

2.5 BOTTOM BEAM

The bottom beam must be constructed of carbon steel and finished per the Section entitled, "Finishes". The bottom beam must be provided with a suitable width and depth to carry the load of the intermediate beams when the door is open, and to ensure full closing and a tight floor seal in heavy winds. A heavy-duty bottom rubber seal must be provided to form a tight seal with the floor. The bottom edge safety device must be integral with the bottom seal.

2.6 WIND LOCK

Each door leaf must have wind locks at each jamb, which activate and lock the bottom beam into place when the door reaches its closed position. This locking action must act to maintain a tight floor seal and intermediate beam stability under design wind conditions. A limit switch or a proximity switch, with indicator must be provided to notify the door operator that all wind locks are engaged properly. Switches located below 18 inches AFF must be compliant with NFPA 70, Class I, Division 2 hazardous environment.

2.7 SWING-UP MULLION WHERE INDICATED

The swing-up mullions must be designed to swing up under the door leaf in the raised position. They must be constructed of carbon steel and finished per the Section entitled, "Finishes". The mullion hinge pivot must be of a maintenance-free bearing design. The swing-up mullion must be raised and lowered by a wire rope hoist with a secondary back-up wire rope arresting system. If the secondary back-up wire rope arresting system is fully integrated into the hoist unit, it must be produced by one manufacturer. Wire rope hoist and secondary system must connect to mullion a minimum of 10 feet above finish floor. Refer to the Section entitled, "Electrical Operation" for controls and interlocks of mullion and door panels.

2.7.1 Mullion Pit and Cover where Indicated

A mullion pit frame, guide plate, and cover(s), manufactured of aluminum or steel, must be provided for each mullion. Hinged cover plates, must be attached to the mullion pit frame. Mullion pit covers must be designed to support a 35,000 pounds force single wheel load with a tire pressure of 200 psi and contact area 1.2 sq ft.

2.7.2 Retractable Mullion Pin and Floor Strike when Utilized

Provide retractable mullion pin with a heavy duty, reversing electric linear actuator. Mullion pin and strike must be designed to resist all mullion design loads and accommodate all vertical movement of the mullion. Floor strike must have hinged cover, funnel shaped at the top, manufactured of aluminum or steel, and must accommodate mullion pin size and pin throw, and must be designed to support a 35,000 pounds force single wheel load

with a tire pressure of 200 psi and contact area 1.2 sq ft. Refer to the Section entitled, "Limit Switches" for information on mullion pin and floor strike limit switches.

2.8 PERSONNEL DOOR

[Personnel doors are not required in Hangar doors.
]
[Hangar door manufacturer must provide exit doors in hangar doors as indicated and required by NFPA 101. Personnel doors must be insulated steel or aluminum doors and as specified in Section [08 11 13 STEEL DOORS AND FRAMES][Section 08 11 16 ALUMINUM DOORS AND FRAMES]. Door must come complete with all hardware including, hinges, lockset, stop, weatherstripping, [illuminated][photoluminescent][reflective] emergency exit sign, and interlock.

]2.9 OPERATION

2.9.1 Door Operation

The vertical lift fabric door must guide up and down in the weather sealed vertical guides attached to the structure. The door must operate by lifting the bottom beam upwards, thereby stacking the intermediate beams one on top of the other, with the fabric panel folding in pleats. The fabric panel must go over the top beam, covering both sides of the door, and must be attached to the intermediate beams by screws and batten strips. When the door is fully closed, the intermediate beams must hang between the two fabric door panels thus pulling the fabric tight. The tension created in the fabric panels must stabilize the intermediate beams. The safety arresters must be attached to each end of the bottom beam and must travel in the vertical guide tracks. The safety arresters must immediately stop the downward movement of the door in case of belt/cable failure.

2.9.2 Electrical Operation

Provide the main control panel with control logic such that when the [integral female pin and sleeve emergency power receptacle is inserted and the integral manual transfer switch associated with the pin and sleeve receptacle is engaged][remote building automatic transfer switch "dry" auxiliary contact with the stationary emergency generator is closed in the "emergency" position] the control panel will automatically limit only one door lift motor or one mullion lift motor to operate at a time.

When the door is completely opened it must stop on the primary top limit switch. In case of over travel, a secondary limit switch must stop the door to prevent damage. The drive unit must be stopped by the slack belt/cable breakers when the door is closed. The slack breakers must also stop the door in case of belt/cable rupture or if an obstruction should prevent the door from being closed. Weight or springs must activate the slack breakers. The control panel station(s) must be of the illuminated pushbutton type or touchscreen.

Door operation must be controlled by three buttons marked "OPEN", "CLOSE", and "STOP". The "OPEN" and "STOP" buttons must require only momentary pressure to operate. The "CLOSE" button must require constant pressure to maintain the closing motion of the door. When the door is in motion and the "STOP" button is pressed or the "CLOSE" button is released, the door must stop instantly and remain in the stop position; from the stop

position, the door must be operated in either direction by the "OPEN" or "CLOSE" buttons. Removing the pressure from the "CLOSE" button must stop the motor drive and set the brake.

Two buttons marked "Horizontal Position and Vertical Position" must control the mullion operation. Both buttons must be controlled by constant pressure to open and to close. Removing the pressure from either button must stop the motor drive and set the brake. The electrical control panel must provide an interlock function to coordinate door leaf and mullion operation.

Pushbuttons must be illuminated by LEDs and utilize simple flashing/solid illumination schemes to inform the operator of door status (fully open, closed, in motion, etc.). In lieu of illuminated pushbuttons, a large touchscreen display must be provided to select desired door leaf/mullion to operate and inform user of current door status. Pushbuttons must be full-guarded to prevent accidental operation.

[Multipart doors must utilize a human machine interface display (HMI) for door leaf/mullion operation. Upon selection, door operation must be controlled by three buttons marked UP, DOWN, and STOP. The UP and STOP buttons must operate as indicated in the door operation controls section above.

When operating a mullion, controls must operate as described in the mullion operation controls above.

The main control panel must be equipped with backup method of controlling the door system should an HMI failure occur.

]2.10 FINISHES

2.10.1 Ferrous Metal

Ferrous metal surfaces must be cleaned, prepared and shop-finished in accordance with Section 09 97 13.27 EXTERIOR COATING OF STEEL STRUCTURES [or hot-dip galvanized in accordance with ASTM A653/A653M, coating designation Z275, for steel sheets, and ASTM A123/A123M for assembled steel products]. Follow coating system manufacturer’s written instructions. All coating of ferrous metal must be shop-finished and the only necessary field painting should be touch-up painting and coating of any unfinished accessories such as bolts and brackets. The following submittals if required by Section 09 97 13.27 are not required for shop-finished vertical lift fabric doors: Work Plans, Coating Inspection Reports, Test Reports, and Qualifications for Certified Industrial Hygienists, Protective Coating Specialists, Blasters, Painters and Inspectors.

2.10.2 Aluminum

Batten strip surfaces must receive [a clear anodized finish, AA-M12-C22-A41 per Aluminum Association Designation System, AA DAF45, in accordance with NAAMM AMP 500 complying with AAMA 611][a high performance organic coating finish, AA-C12C42R1 per Aluminum Association Designation System, AA DAF45, fluoropolymer 2-coat coating system in accordance with NAAMM AMP 500 complying with AAMA 2604].

2.11 SIGNAGE

Provide a placard sign immediately adjacent to the control panel indicating

the following:

Notice:

Vertical lift fabric doors must be closed and not operated when wind speeds above[60 mph][_____] are expected.

Vertical lift fabric doors must be transferred to back-up power for operation when commercial power is not available.

PART 3 EXECUTION

3.1 PROTECTIVE COATINGS

3.1.1 Cleaning

After fabrication, clean all metal surfaces thoroughly of all mill scale, rust, oil, grease and other foreign substances. Apply rust-preventive primer to all steel parts immediately after cleaning.

3.1.2 Shop Painting

After cleaning, coat with primer all steel surfaces other than machine-finished parts. Keep paint off finished bearing surfaces. Before assembly, prime surfaces that will be inaccessible after assembly. Handle painted materials with care to avoid scraping and breaking the protective film. Ferrous metal surfaces that will be exposed after fabrication must be shop coated and touch-up painted in the field by the vertical lift fabric door installer per the Section entitled, "Finishes".

3.1.3 Metal Protection

Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact masonry or concrete, protect against corrosion by painting contact surfaces with bituminous coating.

3.2 ERECTION

Coordinate the erection of the doors with the work of other trades. Ensure that all steel support, bracing and framing members are furnished and accurately installed for the proper installation of the door hardware.

3.2.1 Assembly

Assemble and install the doors and accessories in accordance with the manufacturer's recommendations and installation manual. Secure guides to the walls plum, level, and in-line. Anchor guides at spacing indicated on the manufacturer's installation drawings. Provide additional supports as necessary for attachment of guides, brackets, doors, and operation mechanisms. After erection is complete and before touch-up field painting is applied, thoroughly clean all abraded surfaces, field welds, and field bolts; coat per the Section entitled, "Finishes".

3.2.2 Cleaning

Clean both the interior and exterior of doors after erection.

3.2.3 Control Panel Installation

Locate each door main control panel indoors, adjacent to the door opening, and with an unobstructed line of sight for the entire door opening. All conduit entries must be into the bottom of the control panel. Contractor must mount master control panel and provide three phase power to the control panel.

3.3 ACCEPTANCE TESTING PROCEDURE AND REPORT

The door manufacturer must submit an Acceptance Testing Procedure for approval. After Government approval, the vertical lift fabric door manufacturer must perform the testing and submit a report of the results. The Acceptance testing must include all testing of the door and components performed by the door manufacturer and suppliers. The Acceptance testing will also include the following subparagraphs.

3.3.1 General

Upon completion of installation, including work by other trades, lubricate, adjust, and test doors to verify operation on accordance with manufacturer's product data. Manufacturer's authorized representative must make final adjustment. Adjust and re-test the doors until the entire installation is fully operational and acceptable. Acceptance testing must consist of operating each door and mullion (when included) open and closed (one cycle) ten times successfully and consecutively within a nine-hour time interval in accordance with manufacturer's recommended time interval between open/close cycles. Provide Contracting Officer's Representative an acceptance testing report of completed tests.

3.3.2 Safety Arresters

Perform a non-destructive demonstration of the safety arrester function by engaging the installed safety arresters on the guiderails at a height of 3 feet above closed position. Demonstration must be performed on all doors installed on Project in the presence of the COR.

3.3.3 Personnel Training

The door manufacturer must provide an 8-hour on-site training session for the door operating personnel and maintenance department. The training must outline door operation, troubleshooting and repair guidelines.

3.4 EXTRA MATERIALS

A door fabric patch kit must be supplied with approximately 45 square feet of fabric for each hangar door and all other materials required for door panel repair. Patch kit fabric color and associated materials must match door fabric color provided.

3.5 ELECTRICAL WORK

NFPA 70. Provide all conduit, wiring, and mounting of controls in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

-- End of Section --

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
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.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 1503	(2009) Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
AAMA 501	(2005) Methods of Test for Exterior Walls
AAMA 503	(2008) Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems
AAMA 800	(2010) Voluntary Specifications and Test Methods for Sealants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2009; Errata 2010) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM B221	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM E1105	(2000; R 2008) Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference
ASTM E1424	(1991; R 2008) Standard Test Method for

	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure and Temperature Differences Across the Specimen
ASTM E1886	(2013a) Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
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
ASTM E330	(2002; R 2010) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E331	(2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E783	(2002; R 2010) Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
ASTM F1642	(2012) Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.10	(2011) Power Operated Pedestrian Doors
ANSI/BHMA A156.4	(2013) Door Controls - Closers

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(2004) Glazing Manual

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

16 CFR 1201	Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 325	(2013) Door, Drapery, Gate, Louver, and Window Operators and Systems

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

Conduct pre-installation meeting to verify project requirements, substrate

conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

Within [30] [_____] days of the Contract Award, submit the following for review and approval by the Contracting Officer:

Listing of product installations

Sample warranty

Finish and color samples

Manufacturer's catalog data

Installation drawings

Fabrication drawings for custom fabrications

Concurrently submit certified test reports showing compliance with specified performance characteristics and UL 325 for the following:

a. Air Infiltration ASTM E783

b. Wind Load (Resistance) AAMA 501

c. Deflection ASTM F1642

d. Condensation Resistance and Thermal Transmittance Performance Requirements

e. Water Infiltration ASTM E1105

f. Structural Requirements ASTM F1642

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.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Sample Warranty[; G][; G, [_____]]

Listing of Product Installations[; G][; G, [_____]]

SD-02 Shop Drawings

Installation Drawings[; G][; G, [_____]]

[Fabrication Drawings[; G][; G, [_____]]
]

SD-03 Product Data

Manufacturer's Catalog Data[; G][; G, [_____]]

SD-04 Samples

Finish and Color Samples[; G][; G, [_____]]

SD-06 Test Reports

Certified Test Reports[; G][; G, [_____]]

SD-07 Certificates

Manufacturer's Product Warranty[; G][; G, [_____]]

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Installer Qualifications

Provide documentation of Installer experience [as determined by Contractor] to perform work of this section, who has specialized in the installation of work similar to that required for this project, and who is acceptable to product manufacturer.

1.4.1.2 Manufacturer Qualifications

Manufacturers are acceptable providing they meet the requirements specified in this section and project drawings.

Ensure manufacturer is capable of providing field service representation during construction, approving acceptable installer and approving application method.

1.4.2 Single Source Responsibility

When aluminum entrances are part of a building enclosure system, including storefront framing, windows, curtain wall system and related products, provide building enclosure system products from a single source manufacturer.

Provide design, structural engineering, and custom fabrication for door portal system and supply of all components, materials, and products based on a single manufacturer of sole responsibility. Provision of products from numerous sources for site assembly without complete single source design and supply responsibility is not acceptable. Work items and components to be fabricated or supplied by single source are:

a. Door assemblies to be installed in door portal as specified in [Section 08 11 16 ALUMINUM DOORS AND FRAMES][_____].

b. Glazed wall to be constructed around door portal as specified in [this Section][_____].

c. Door operating hardware to be installed on or within door portal as specified in Section 08 71 00 DOOR HARDWARE.

d. Glass as specified in [Section 08 81 00 GLAZING][_____].

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Ordering

Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

1.5.2 Packing, Shipping, Handling and Unloading

Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

1.5.3 Storage and Protection

Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

1.6 PROJECT / SITE CONDITIONS

1.6.1 Field Measurements

Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

This Specification includes aluminum entrances, glass and glazing, door hardware, and components.

Type of Aluminum Entrance includes:

Impact Resistance Entrances; medium stile, 3-1/2 inch vertical face dimension, 1-3/4 inch depth, interior structural silicone glazed, high traffic/impact resistant applications.

2.1.1 Design Requirements for Aluminum (Entrances and Components)

Design, size components, and install door portal system to withstand these loads without breakage, loss, failure of seals, product deterioration, and other defects, AAMA 503.

a. Dead and Live Loads: Determined by ASCE 7 and calculated in accordance with applicable codes.

b. Seismic Loads: Design and install system to comply with applicable seismic requirements for project location as defined by Section 1613 of the International Building Code (IBC).

c. Effects of applicable wind load acting inward and outward normal to plane of wall in accordance with ASTM E330.

d. Thermal Loads And Movement:

(1) Ambient Temperature Range: [.][[120][_____] degrees F.]

(2) Material Surfaces Range: [.][[180][_____] degrees F.]

e. Provide and install weatherstripping, exterior gaskets, sealants, and other accessories to resist water and air penetration.

f. Impact Protective Systems ASTM E1886.

2.1.1.1 Material Standard

ASTM B221 ASTM B221M; 6063-T5 alloy and tempered.

Provide door stile and rail face dimensions of the entrance doors as follows:

Vertical Stile	Top Rail	Bottom Rail
3-1/2 inches	3-1/2 inches	6-1/2 inches

Provide major portions of the door members at.125 inches nominal in thickness and glazing molding to be .050 inches thick.

2.1.1.2 Tolerances

Reference to tolerances for wall thickness and other cross-sectional dimensions of entrance members are nominal and in compliance with Aluminum Standards and Data, published by The Aluminum Association.

Provide either EPDM elastomeric extrusions or thermoplastic elastomer glazing gaskets. Structural silicone sealant is required.

2.1.2 Performance Requirements

2.1.2.1 Air Infiltration

Submit certified test reports showing compliance with specified performance characteristics as follows:

a. For single acting offset pivot, butt hung or continuous geared hinge entrances in the closed and locked position, test the specimen in accordance with ANSI/BHMA A156.10, and ASTM E283 at a pressure differential of 1.57 psf for pairs of doors; maximum infiltration for a pair of 7 foot - 0 inch by 8 foot - 0 inch entrance doors and frame is 1.2 cfm/ft2.

b. Maximum allowable infiltration, for a completed storefront system is not to exceed 0.06 cfm/square foot when tested in accordance with ASTM E1424 at differential static pressure of 6.24 psf.

2.1.2.2 Wind Loads

Provide completed storefront system capable of withstanding wind pressure loads, normal to the wall plane indicated, as follows:

a. Exterior Walls

(1) Positive Pressure: [_____] psf

(2) Negative Pressure: [_____] psf

b. Interior Walls: (pressure acting in either direction) [_____] psf

2.1.2.3 Deflection

Submit certified test reports showing compliance with specified performance characteristics as follows:

The maximum allowable deflection in any member when tested in accordance with ASTM E330 with allowable stress in accordance with AA Specifications for Aluminum Structures is L/175 or 3/4 inches maximum.

2.1.2.4 Condensation Resistance and Thermal Transmittance

Submit certified test reports showing compliance with specified performance characteristics as follows:

a. U-Value Requirements:

(1) Perform test in accordance with AAMA 1503 procedure and on the configuration specified therein.

(2) Thermal Transmittance ("U" Value) maximum [_____][0.65 (6250) BTU/hr/sf/deg F] at [15] mph exterior wind.

b. CRF Class Requirements:

(1) Perform test in accordance with AAMA 1503.

(2) Condensation Resistance Factor Requirements (CRF) minimum [_____].

2.1.2.5 Water Infiltration

Submit certified test reports showing compliance with specified performance characteristics as follows:

System is designed to provide no uncontrolled water when tested in accordance with ASTM E331 at a static pressure of 8 psf.

2.2 FABRICATION

2.2.1 Entrance System Fabrication

Provide door corner construction consisting of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8 inch long fillet welds inside and outside of all four corners. Provide hook-in type exterior glazing stop with EPDM glazing gaskets reinforced with non-stretchable cord. Provide interior glazing stop mechanically fastened to the door member incorporating a silicone compatible spacer used with silicone sealant.

Accurately fit and secure joints and corners. Make joints hairline in appearance. Prepare components with internal reinforcement for door hardware. Arrange fasteners and attachments to conceal from view.

2.2.2 Shop Assembly

Fabricate and assemble units with joints only at intersection of aluminum members with hairline joints; rigidly secure, and sealed in accordance with

manufacturer's recommendations.

2.2.2.1 Welding

Conceal welds on aluminum members in accordance with AWS recommendations or methods recommended by manufacturer. Members showing welding bloom or discoloration on finish or material distortion will be rejected.

2.2.3 Fabrication Tolerance

Fabricate and assemble units with joints only at intersection of aluminum members with hairline joints; rigidly secure, and sealed in accordance with manufacturer's recommendations.

Fabricate aluminum entrances in accordance with entrance manufacturer's prescribed tolerances.

2.2.3.1 Material Cuts

Square to 1/32 inch off square, over largest dimension; proportionate amount of 1/32 inch on the two dimensions.

[2.2.3.2 Maximum Offset At Consecutive Members

1/64 inch in alignment between two consecutive members in line, end to end.

][2.2.3.3 Maximum Offset At Glazing Pocket Corners

1/64 inch between framing members at glazing pocket corners.

]2.2.3.4 Joints

(Between adjacent members in same assembly: Hairline and square to adjacent member.

2.2.3.5 Variation

In squaring diagonals for doors and fabricated assemblies: 1/16 inch.

2.2.3.6 Flatness

For doors and fabricated assemblies: plus/minus 1/16 inch of neutral plane.

2.3 ACCESSORIES

2.3.1 Fasteners

Provide stainless steel where exposed.

2.3.2 Perimeter Anchors

When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

2.3.3 Standard Entrance Hardware

2.3.3.1 Weatherstripping

Equip meeting stiles on pairs of doors with an adjustable astragal

utilizing wool pile with polymeric fin.

Provide door weatherstripping on a single acting offset pivot or butt hung door and frame (single or pairs) comprised of a thermoplastic elastomer weatherstripping on a tubular shape with a semi-rigid polymeric backing.

Provide Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners. (Provide as necessary to meet specified performance tests.)

2.3.3.2 Threshold

Provide extruded aluminum threshold, one piece per door opening, with ribbed surface.

2.3.3.3 Offset Pivots

Provide manufacturer's standard top and bottom pivots with one intermediate offset pivot.

2.3.3.4 Panic Device

Provide manufacturer's recommended standard panic hardware.

2.3.3.5 Closer

Provide surface closer only per ANSI/BHMA A156.4.

2.3.3.6 Security Lock/Dead Lock

Provide A/R MS 1850A lock with (2) A/R 1871 cylinder operated flush bolts.

2.3.3.7 Cylinder(s)/Thumb-turn

Provide manufacturer's recommended standard.

2.3.3.8 Cylinder Guard

Manufacturer standard.

2.4 RELATED MATERIALS

2.4.1 Sealants

[Refer to Section 07 92 00 JOINT SEALANTS.]Ensure all sealants conform to AAMA 800.

2.4.2 Glass

Refer to Section 08 81 00 GLAZING.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Site Verification of Conditions

Verify substrate conditions (which have been previously installed under

other sections) are acceptable for product installation in accordance with manufacturer's instructions.

Verify openings are sized to receive storefront system and sill plate is level in accordance with manufacturer's acceptable tolerances.

3.2 INSTALLATION

Install entrance system in accordance with manufacturer's instructions and AAMA storefront and entrance guide specifications manual. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities. Provide alignment attachments and shims to permanently fasten system to building structure. Align assembly plumb and level, free of warp and twist. Maintain assembly dimensional tolerances aligning with adjacent work.

Set thresholds in bed of mastic and secure. Protect aluminum members in contact with masonry, steel, concrete, or dissimilar materials using nylatron pads or bituminous coating. Shim and brace aluminum system before anchoring to structure. Verify weep holes are open, and metal joints are sealed in accordance with manufacturer's installation instructions. Seal metal to metal joints using sealant recommended by system manufacturer.

3.2.1 Preparation

Field verify dimensions prior to fabricating door portal assembly components.

Coordinate requirements for locations of blockouts for anchorage of door portal columns and other embedded components with Section 03 30 00 CAST-IN-PLACE CONCRETE.

Coordinate erection of door portal with installation of surrounding glass wall and door assemblies. Ensure adequate provision is made for support and anchorage of assembly components.

Coordinate electrical requirements for [automatic door assemblies][electrified door hardware] to ensure proper power source, conduit, wiring, and boxes.

3.2.1.1 Adjacent Surfaces Protection

Protect adjacent work areas and finish surfaces from damage during product installation.

3.2.1.2 Aluminum Surface Protection

Protect aluminum surfaces from contact with lime, mortar, cement, acids, and other harmful contaminants.

3.2.2 Adjusting

Adjust operating hardware for smooth operation, and as recommended by the manufacturer.

3.2.3 Related Products Installation Requirements

3.2.3.1 Sealants (Perimeter)

Refer to Section 07 92 00 JOINT SEALANTS.

3.2.3.2 Glass

Refer to Section 08 81 00 GLAZING.

3.2.3.3 Reference

ANSI Z97.1, 16 CFR 1201 and GANA Glazing Manual.

3.3 PROTECTION AND CLEANING

3.3.1 Protection

Protect installed product's finish surfaces from damage during construction. Protect aluminum storefront system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

3.3.2 Cleaning

Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

3.4 WARRANTY

Submit [three] [_____] signed copies of manufacturer's product warranty for entrance system as follows:

Warranty Period: [Five] [_____] years from Date of Substantial Completion of the project, provided that the Limited Warranty begins in no event later than [six] [_____] months from date of shipment by manufacturer. In addition, support welded door corner construction with a limited lifetime warranty for the life of the door under normal use.

Ensure Warranty language is identical to "As Approved" version of the sample warranty submitted and returned from the Contracting Officer.

-- 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
ASTM F883	(2013) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2013) Butts and Hinges
ANSI/BHMA A156.12	(2013) Interconnected Locks & Latches
ANSI/BHMA A156.13	(2012) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16	(2013) Auxiliary Hardware
ANSI/BHMA A156.17	(2004; R 2010) Self Closing Hinges & Pivots
ANSI/BHMA A156.18	(2012) Materials and Finishes
ANSI/BHMA A156.2	(2011) Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21	(2009) Thresholds
ANSI/BHMA A156.3	(2014) Exit Devices
ANSI/BHMA A156.4	(2013) Door Controls - Closers
ANSI/BHMA A156.5	(2014) Auxiliary Locks and Associated Products
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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2012; Amendment 1 2012) Life Safety Code

NFPA 80 (2013) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8 (2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 14C (2006; Reprint May 2013) Swinging Hardware for Standard Tin-Clad Fire Doors Mounted Singly and in Pairs

UL Bld Mat Dir (2012) Building Materials Directory

1.2 SUBMITTALS

Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Hardware schedule[; G][; G, [_____]]

Keying system

SD-03 Product Data

Hardware items[; G][; G, [_____]]

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1[; G][; 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.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, [pivots,] and closers of one lock, hinge, [pivot,] or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.5.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. [Deliver permanent keys [and removable cores] to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.]

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal [or to prefinished doors] manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements indicated, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." [Conform to UL 14C for swinging hardware for the tin-clad fire doors.] Provide the label of Underwriters Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

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.

2.3.1.1 [Protection Devices

Provide full height hand and finger protection device at the hinge-side area opening of doors and gates. Hinge-side protection device shall be provided on both sides of the doors and gates, covering hinges and space between door and frame when doors are in the open position. The installed device shall push hand and/or fingers out of the opening and away from a crushing hazard.

]2.3.2 Pivots

ANSI/BHMA A156.4.

2.3.3 Spring Hinges

ANSI/BHMA A156.17.

2.3.4 Locks and Latches

2.3.4.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. [Provide factory-installed lead lining in locks for lead-shielded doors.] [Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges.] Install knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.4.2 Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 1. [Provide factory-installed lead lining in locks for lead-shielded doors.]

2.3.4.3 Residential Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 2. Install locks for exterior doors with threaded roses or concealed machine screws.

2.3.4.4 [Interconnected Locks and Latches

ANSI/BHMA A156.12. Provide F96 or F97, unless otherwise specified.]

2.3.4.5 Hospital Latches

Push-pull latchset similar and equal to Glynn-Johnson HL6, 1/2 inch throw, [2-3/4 inch] [5 inch] backset, to fit 161 cutout. Cover approximately 2-1/2 by 5-1/2 inch, handle approximately 1-1/2 by 4-1/2 inch, projection approximately 2-1/2 inch, covers and handles of stainless steel, BHMA 630 finish, engraved "PUSH" and "PULL" on handles, push handle pointing up, pull handle pointing down.

2.3.4.6 Auxiliary Locks

ANSI/BHMA A156.5, Grade 1.

2.3.4.7 Combination Locks

[Pharmacy door locks shall be keyed separately from building master key system.]Heavy-duty, mechanical combination lockset with five pushbuttons, standard-sized knobs, 3/4 inch deadlocking latch, 2-3/4 inch backset. Operate the locks by pressing two or more of the buttons in unison or individually in the proper sequence. Inside knob will operate the latch. Provide a keyed cylinder on the interior to permit setting the combination. [Provide a keyed [removable-core] cylinder on the exterior to permit bypassing the combination.] [Provide a thumb turn on the interior to activate passage set function, so that outside knob operates latch without using the combination.]

2.3.5 Exit Devices

ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide [touch bars in lieu of conventional crossbars and arms.] [Provide escutcheons, not less than 7 by 2-1/4 inch.]

2.3.6 Exit Locks With Alarm

ANSI/BHMA A156.5, Type E0431 (with full-width horizontal actuating bar) for single doors; Type E0431 (with actuating bar) or E0471 (with actuating bar and top and bottom bolts, both leaves active) for pairs of doors, unless otherwise specified. [Provide terminals for connection to remote indicating panel.] [Provide outside control key.]

2.3.7 Cylinders and Cores

[Provide cylinders and cores for new locks, including locks provided under other sections of this specification.] Provide cylinders and cores with [six] [seven] pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer. [Rim cylinders, mortise cylinders, and knobs of bored locksets have

interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.]

[Provide cylinders for new locks, including locks provided under other sections of this specification. Provide fully compatible cylinders with products of the Best Lock Corporation with interchangeable cores which are removable by a special control key. Factory set the cores with [six] [seven] pin tumblers using the A4 system and F keyway. Submit a core code sheet with the cores. Provide master keyed cores in one system for this project. Provide construction interchangeable cores.]

[For medical projects, pharmacy door locks shall be keyed separately from building master key system.]

2.3.8 Keying System

Provide [a [great] [grand] master keying system] [an extension of the existing keying system. Existing locks were manufactured by [_____] and [do not] have interchangeable cores.] [Provide [a construction master keying system] [construction interchangeable cores].] [Provide key cabinet as specified.]

Provide [sub-master keying system for [the] [each] building, and keyed to the existing Best removable-core master and grand master keying systems. Key equipment spaces and mechanical rooms separately from the building systems, and keyed alike to the existing Best master and grand master systems for these doors.]

[The Government will provide permanent cylinders with cores and keys for mortise locksets, auxiliary locks, and exit devices. Furnish cylinders as manufactured by Best Lock Corp., Arrow Lock Corp., or Falcon Lock. Notify the Contracting Officer 90 days prior to the required delivery of the cylinders. Provide temporary cores and keys for the Contractor's use during construction, and for testing the locksets.]

2.3.9 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.9.1 Knobs and Roses

Conform to the minimum test requirements of ANSI/BHMA A156.2 and ANSI/BHMA A156.13 for knobs, roses, and escutcheons. For unreinforced knobs, roses, and escutcheons, provide 0.050 inch thickness. For reinforced knobs, roses, and escutcheons, provide outer shell of 0.035 inch thickness, and combined thickness of 0.070 inch, except for knob shanks, which are 0.060 inch thick.

2.3.9.2 Lever Handles

Provide lever handles in lieu of knobs [where indicated in paragraph entitled "Hardware Schedule"]. Conform to the minimum requirements of 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.

2.3.9.3 Texture

Provide knurled or abrasive coated knobs or lever handles[where specified in paragraph entitled "Hardware Schedule"][for doors which are accessible to blind persons and which lead to dangerous areas].

2.3.10 Keys

Furnish one file key, one duplicate key, and one working key for each key change [and for each master [and grand master] keying system]. Furnish one additional working key for each lock of each keyed-alike group. [Furnish two additional keys for each sleeping room.] [Furnish [[_____] great grand master keys,] [[_____] construction master keys,] [and [_____] control keys for removable cores].] [Furnish a quantity of key blanks equal to 20 percent of the total number of file keys.] Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

[Furnish seven change keys for each interchangeable core, furnish two control keys, six maters keys, and six construction master keys. [Furnish a quantity of key blanks equal to 20 percent of the total number of change keys.] Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room numbers on keys.]

2.3.11 Door Bolts

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.

2.3.12 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, [full size covers, except at storefront mounting,] [pivots,] [cement cases,] and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.12.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.13 Overhead Holders

ANSI/BHMA A156.8.

2.3.14 Closer Holder-Release Devices

BHMA A156.15.

2.3.15 Door Protection Plates

ANSI/BHMA A156.6.

2.3.15.1 Sizes of [Armor] [Mop] [and] Kick Plates

2 inch less than door width for single doors; one inch less than door width for pairs of doors. Provide [[8] [10] inch kick plates for flush doors] [and] [1 inch less than height of bottom rail for panel doors]. Provide a minimum [36] [48] [_____] inch armor plates for flush doors [and] completely cover lower panels of panel doors, except 16 inch high armor plates on fire doors. Provide [4] [6] inch mop plates.

2.3.16 Edge Guards

ANSI/BHMA A156.6, stainless steel, of same height as armor plates. Apply to [hinge stile] [lock stile] [meeting stiles].

2.3.17 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.18 Padlocks

ASTM F883.

2.3.19 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.

2.3.20 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals[, sweep strips,] [and, for pairs of doors, astragals]. Air leakage of weather stripped doors not to exceed [0.5] [1.25] cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weather stripping with one of the following:

2.3.20.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide [clear (natural)] [bronze] anodized aluminum.

2.3.20.2 Interlocking Type

Zinc or bronze not less than 0.018 inch thick.

2.3.20.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.008 inch thick.

2.3.21 [Lightproofing] [and] [Soundproofing] Gasketing

BHMA A156.22. Include adjustable doorstops at head and jambs and an automatic door bottom per set, both of extruded aluminum, [clear (natural)] [bronze] anodized, surface applied, with vinyl fin seals between plunger and housing. Provide doorstops with solid neoprene tube, silicone rubber, or closed-cell sponge gasket. Furnish door bottoms with adjustable operating rod and silicone rubber or closed-cell sponge neoprene gasket.

Doorstops mitered at corners. Provide the type and function designation where specified in paragraph entitled "Hardware Sets".

2.3.22 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, [clear] [bronze] anodized. Set drips in sealant and fasten with stainless steel screws.

2.3.22.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.3.22.2 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.

2.3.23 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

[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] [prime coat] finish for surface door closers, and except [BHMA 652 finish (satin chromium plated)] [BHMA 600 finish (primed for painting)] for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish [except where BHMA 630 is specified under paragraph entitled "Hardware Sets"]. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.]

[ANSI/BHMA A156.18. Provide hardware in BHMA 612 finish (satin bronze), unless specified otherwise. Finish surface door closers [bronze paint] [prime coat] finish. Provide steel hinges in [BHMA 639 finish (satin bronze plated)] [BHMA 600 finish (primed for painting)]. Provide exposed parts of concealed closers finish to match lock and door trim. Match hardware finish for aluminum doors to match the doors. Provide hardware showing on interior of [bathrooms] [shower rooms] [toilet rooms] [washrooms] [laundry rooms] [and kitchens] in BHMA 629 finish (bright stainless steel) or BHMA 625 finish (bright chromium plated).]

2.6 KEY CABINET AND CONTROL SYSTEM

ANSI/BHMA A156.5, [Type [E8331 (25 hooks)] [E8341 (125 hooks)] [E8351 (150 hooks)] [E8311 (600 hooks)] [E8321 (700 hooks)].] [Type required to yield

a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.]

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door 1 inch on center and to heads and jambs at 4 inch on center

3.1.1.3 Spring Tension Type Weather Stripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze, stainless steel nails with stainless steel. Space nails not more than 1-1/2 inch on center.

3.1.2 [Lightproofing] [and] [Soundproofing] Installation

Install as specified for stop-applied weather stripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws [in expansion sleeves].

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors [, and UL 14C for swinging tin-clad fire doors].

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where [directed] [indicated]. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

Provide [hardware for aluminum doors under this section. Deliver Hardware templates and hardware, except field-applied hardware to the aluminum door and frame manufacturer for use in fabricating the doors and frames.]

-- End of Section --

SECTION 08 81 00

GLAZING
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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2009; Errata 2010) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C1036	(2010; E 2012) Standard Specification for Flat Glass
ASTM C1048	(2012; E 2012) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C1172	(2009; E 2011) Standard Specification for Laminated Architectural Flat Glass
ASTM C1184	(2014) Standard Specification for Structural Silicone Sealants
ASTM C509	(2006; R 2011) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C864	(2005; R 2011) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D2287	(2012) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D395	(2014) Standard Test Methods for Rubber Property - Compression Set
ASTM D4802	(2010) Poly(Methyl Methacrylate) Acrylic

Plastic Sheet

ASTM E119 (2012a) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E1300 (2012a; E 2012) Determining Load Resistance of Glass in Buildings

ASTM E2129 (2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products

ASTM E2226 (2012) Standard Practice for Application of Hose Stream

ASTM E413 (2010) Rating Sound Insulation

ASTM E90 (2009) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual (2004) Glazing Manual

GANA Sealant Manual (2008) Sealant Manual

GANA Standards Manual (2001) Tempering Division's Engineering Standards Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-3001 (2001) Guidelines for Sloped Glazing

IGMA TM-3000 (1990; R 2004) North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use

IGMA TR-1200 (1983; R 2007) Guidelines for Commercial Insulating Glass Dimensional Tolerances

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (2014) Procedure for Determining Fenestration Product U-Factors

NFRC 200 (2014) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252 (2012) Standard Methods of Fire Tests of Door Assemblies

NFPA 257 (2012) Standard on Fire Test for Window and Glass Block Assemblies

NFPA 80	(2013) Standard for Fire Doors and Other Opening Protectives

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

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

16 CFR 1201	Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 752	(2005; Reprint Jul 2011) Standard for Bullet-Resisting Equipment
UL MEAPD	(2011) Mechanical Equipment and Associated Products Directory (online version is listed under Certifications at www.ul.com)

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

[Control Tower Insulating Glass]

[Control Tower Laminated Glass]

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

[SD-03 Product Data

Insulating Glass

Documentation for Energy Star qualifications.

Plastic Glazing

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

[Local/Regional Materials; (LEED NC)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Environmental Data]]

SD-04 Samples

Insulating Glass

Plastic Sheet

Glazing Compound

Glazing Tape

Sealant

Two 8 by 10 inch samples of each of the following: tinted glass, patterned glass, heat-absorbing glass, [_____] and insulating glass units.

Three samples of each indicated material. Samples of plastic sheets shall be minimum 5 by 7 inches.

[SD-07 Certificates

Insulating Glass

Plastic Glazing

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

[Control Tower Insulating Glass]

[Control Tower Laminated Glass]

Glazing Accessories

Certificates from the manufacturer attesting that the units meet the luminous and solar radiant transmission requirements for heat absorbing glass.]

SD-08 Manufacturer's Instructions

Setting and sealing materials

Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.[Include cleaning instructions for plastic sheets.]

SD-11 Closeout Submittals

Local/Regional Materials; LEED NC

LEED (tm) documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

[1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E1300.

]1.4 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [500][_____] mile radius from the project site, if available from a minimum of three sources.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Glazing materials may be locally available.]

1.6.2 Environmental Data

[Submit Table 1 of ASTM E2129 for the following products: [_____].]

1.7 WARRANTY

1.7.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government. [For control tower units, the warranty period shall be [10][_____] years; warranty shall be signed by the manufacturer.]

1.7.2 Warranty for Polycarbonate Sheet

For a 5-year period following acceptance of the work:

a. Warranty Type I, Class A (UV stabilized) sheets against breakage;

b. Warranty Type III (coated, mar-resistant) sheets against breakage and against coating delamination;

c. Warranty Type IV (coated sheet) against breakage and against yellowing;

d. Warranty extruded polycarbonate profile sheet against breakage.

For a 10-year period following acceptance of the work, warranty Type IV against yellowing and loss of light transmission.

[1.7.3 Monolithic Reflective Glass

Manufacturer shall warrant the monolithic reflective glass to be free of peeling or deteriorating of coating for a period of 10 years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

][1.7.4 Monolithic Opacified Spandrel

Manufacturer shall warrant the opacifier film on the spandrel to be free of peeling for a period of five years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

]PART 2 PRODUCTS

2.1 GLASS

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

[For interior glazing (i.e., pass and observation windows), 1/4 inch thick glass should be used.]

Type I, Class 1 (clear), Quality [q4 (A)] [q5 (B)]. Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not

over 45 square feet.

2.1.2 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - [clear] [tinted], Quality q3 - glazing select, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Color shall be [[gray] [bronze] [_____]].

2.1.3 Heat-Absorbing Glass

Type I, Class 2 (heat absorbing and light reducing), Quality [q3 (select)] [q4 (A)], [_____] inch thick, [blue][green] in color, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Color shall be [[gray] [bronze] [_____]] for 1/4 inch thickness.

2.1.4 Wired Glass

Glass for fire-rated windows shall be UL listed and shall be rated for [45] [20] minutes when tested in accordance with ASTM E2226. Wired glass shall be Type II flat type, Class [1 - translucent] [2 - tinted, heat-absorbing] [3 - tinted, light-reducing], Quality [q7 - decorative] [q8 - glazing], Form [1 - wired and polished both sides] [2 - patterned and wired], [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Wire mesh shall be polished stainless steel Mesh [1 - diamond] [2 - square] [3 - parallel]. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for [20] [45] minutes when tested in accordance with NFPA 257. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252.

2.1.5 Patterned Glass

Type II, Class 1 (translucent), Form 3 (patterned), Quality q7 (decorative), Finish [f1 (patterned one side)] [f2 (patterned two sides)], Pattern [p1 (linear)] [p2 (geometric)] [p3 (random)] [p4 (special)], [[_____] percent light transmittance, [_____] percent shading coefficient.] [1/8] [7/32] inch thick. [Provide [_____].]

2.1.6 Laminated Glass

[ASTM C1172, Kind LA fabricated from two nominal [1/8][_____] inchpieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass shall be laminated together with a minimum of 0.030 inchthick, clear polyvinyl butyral interlayer. The total thickness shall be nominally 1/4 [_____] inch.] [Fabricated from two pieces of Type I, Class 1, Quality q3 glass laminated together with a clear [_____] [0.015] inch thick polyvinyl butyral interlayer or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C1172. Color shall be [[clear] [gray] [bronze] [_____]] . The total thickness shall be nominally [_____] inch. [Provide [_____].]]

2.1.7 Bullet-Resisting Glass

Fabricated from Type I, Class 1, Quality q3 glass with polyvinyl butyral plastic interlayers between the layers of glass and listed by UL MEAPD as bullet resisting, with a power rating of [Medium--Small Arms] [High--Small Arms] [Super--Small Arms] [High--Rifle] in accordance with UL 752. Provide

[_____] [where indicated].

[2.1.8 Mirrors

2.1.8.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint , and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

]2.1.9 One-Way Vision Glass (Transparent Mirrors)

Type I, Class 1, Quality q1, 1/4 inch thick, coated on one face with a hard, adherent film of chromium or other approved coating of equal durability. Glass shall transmit not less than 5 percent or more than 11 percent of total incident visible light and shall reflect from the front surface of the coating not less than 45 percent of the total incident visible light. [Provide [_____].]

2.1.10 Tempered Glass

ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class [1 (transparent)] [2 (tinted heat absorbing)], Quality q3, [_____] inch thick, [_____] percent light transmittance, [_____] percent shading coefficient conforming to ASTM C1048 and GANA Standards Manual. Color shall be [[clear] [bronze] [gray] [_____]]. [Provide [_____]] [and wherever safety glazing material is indicated or specified].

2.1.11 Heat-Strengthened Glass

ASTM C1048, Kind HS (heat strengthened), Condition A (uncoated), Type I, Class [1 (clear)] [2 (tinted heat absorbing)], Quality q3, [_____] inch thick. [Provide [_____].]

2.1.12 Spandrel Glass

2.1.12.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass shall be Kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 2 surface, Quality q3 - glazing select, [_____] inchthick, conforming to ASTM C1048. Glass performance shall be R-Value/Winter Nighttime [_____], shading coefficient [_____]. Color shall be [_____].

2.1.12.2 Film-Opacified Spandrel Glass

Film-opacified spandrel glass shall be Kind HS heat-strengthened transparent flat type, Quality q3 - glazing select, Condition C glass with a polyester or polyethylene film 2 mils to 5 mils thick attached to No. 2

surface of a sputtered solar-reflective film, conforming to ASTM C1048. Film opacification shall be compatible to and specifically developed for application to solar reflective films. Glass performance shall be R-Value/Winter Nighttime [_____], shading coefficient [_____]. Color shall be [_____].

2.1.12.3 Spandrel Glass With Adhered Backing

ASTM C1048, Kind HS or FT, Condition B (ceramic coated), Type I, Quality q5, [_____] inch thick and shall pass the fallout resistance test specified in ASTM C1048. [Provide [_____].]

2.1.13 Fire/Safety Rated Glass

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a [20] [45] [60] [_____] minute rating when tested in accordance with ASTM E119. Glass shall be permanently labeled with appropriate markings.

2.1.14 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. [Color shall be [[gray] [bronze] [_____]] [as shown in Section 09 06 90 COLOR SCHEDULE].]

2.2 INSULATING GLASS UNITS

Two panes of glass separated by [a dehydrated [1/2 inch airspace, filled with argon][3/8 inch airspace, filled with krypton] gas,][[0.63][1.26][_____] inches of aerogel] and hermetically sealed. [Residential windows (including frames and glass) shall be Energy Star qualified products as appropriate to [Northern] [North/Central] [South/Central] [Southern] climate zone.] [Non-residential glazed systems (including frames and glass) shall be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of [_____] determined according to NFRC 200 procedures and a U-factor maximum of [_____] [Btu/hr-ft2-F] in accordance with NFRC 100.] Glazing shall meet or exceed a luminous efficacy of 1.0. Glazed panels shall be rated for not less than [26] [30] [35] [_____] Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413. Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be black, roll-formed, [thin-gauge, C-section steel] [steel-reinforced butyl rubber] [thermally broken aluminum] [polyurethane and silicon foams], with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

2.2.1 Buildings

Two panes of glass separated by a dehydrated airspace[, filled with argon gas][, filled with krypton gas,][, filled with aerogel] and hermetically sealed.

[Insulated glass units shall have a Solar Heat Gain Coefficient (SHGC) maximum of [_____]and a U-factor maximum of [_____] Btu per square foot by hr by degree F.]

[Glazing shall meet or exceed a luminous efficacy of 1.0.] [See section[s][_____] for energy performance requirements for glazed systems (glazing and frames).] [Glazed panels shall be rated for not less than [26] [30] [35] [_____] Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.]

Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be black, roll-formed,
[thin-gauge, C-section steel] [steel-reinforced butyl rubber] [thermally broken aluminum] [polyurethane and silicon foams], with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

The inner light shall be [ASTM C1172, clear annealed flat glass Type I, Class I, Quality q3] [ASTM C1036, Type I, Class 1, Quality q4, [_____] inch thick] [ASTM C1048, Grade B (fully tempered), Style I (uncoated), Type I, Class 1 (transparent), Quality q4, [_____] inch thick]. The outer light shall be [ASTM C1036, Type I, Class [1 (transparent)] [2 (tinted heat absorbing)], [2 (solar-reflective)], Quality q4, [_____] inch thick] [ASTM C1048, Grade B (fully tempered), Style I (uncoated), Type I, Class [1 (clear)] [2 (tinted heat absorbing)][solar-reflective], Quality q4, [_____] inch thick].

2.2.2 Control Towers

Control tower glass units shall be of sizes required to properly fit aluminum frames. Tolerances and clearances for units shall be designed to prevent the transfer of stress in aluminum frames to the glass. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, glazing sealants, and resilient channels or cemented-on-materials shall be of the type recommended in the glass manufacturer's approved written instructions. Edges and corners of units shall not be ground, nipped, cut, or fitted after leaving the factory.

2.2.2.1 Control Tower Insulating Glass

Insulating glass units for air traffic control towers shall meet the wind load design requirement of [_____] psi, as determined in accordance with ASCE 7. Insulating glass shall be Class A preassembled units of dual-seal construction consisting of two lites of glass separated by a dark bronze aluminum, steel, or stainless steel, spacer with desiccant and dehydrated space. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints, to completely seal the spacer periphery to eliminate moisture and hydrocarbon vapor transmission into airspace through corners. Primary seal shall be compressed polyisobutylene. Secondary seal shall be silicone. Insulating glass units shall be fabricated for use at an

elevation of [_____] feet above mean sea level and [_____] feet above grade. Within bottom 1/3 of one of the vertical edges of each unit, the manufacturer shall install an open 12 inch long capillary/breather tube for pressure equalization. The insulating glass units shall be free of parallax or optical distortions. The manufacturer's identifying label shall be permanently affixed to both exterior surfaces of the glass units. The insulating glass units shall be a total thickness of 1 inch consisting of two 1/4 inch thick panels and air space, or a total thickness of 1-1/4 inch consisting of two 3/8 inch thick panels and air space, or a total thickness of 1-1/2 inch consisting of two 1/2 inch thick panels and an air space, as required to meet the wind loads indicated. Glass type shall be as follows.

2.2.2.2 Control Tower Heat-Absorbing Insulating Glass

Heat-absorbing insulating glass shall consist of two glass panels separated by an air space and shall conform to ASTM C1036, Type I, transparent flat glass, Style A, Quality q3 - glazing select. Interior glass shall be Class 1-clear and exterior glass shall be Class 2-tinted green. Glass performance shall be minimum Visible Transmittance of [70.8] [_____] percent for each panel and R-Value of 1.85 for the unit.

2.2.2.3 Control Tower Clear Insulating Glass

Clear insulating glass shall consist of two float glass panels separated by an air space and shall conform to ASTM C1036, Type I transparent flat glass, Quality q3-glazing select. Interior glass and exterior glass shall be Class 1-clear. Glass performance shall be minimum Visible Transmittance of [87.3] [_____] percent for each panel and R-Value of 1.85 for each unit.

2.2.2.4 Control Tower Laminated Glass

Laminated glass units for air traffic control towers shall meet the wind load design requirement of [_____] psi, as determined in accordance with ASCE 7. ASTM C1172, Kind LA fabricated from two nominal 1/2 inchpieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass shall be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral interlayer or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C1172. The total thickness shall be nominally 1 inch. Color shall be [[clear] [gray] [bronze] [_____]]. [Provide [_____].]

2.2.3 Low Emissivity Insulating Glass

Interior and exterior glass panes for Low-E insulating units shall be Type I annealed flat glass, Class [1-clear] [2-tinted] with anti-reflective low-emissivity coating on [No. 2 surface (inside surface of exterior pane)][No. 3 surface (inside surface of interior pane)], Quality q3 - glazing select, conforming to ASTM C1036. Glass performance shall be U value maximum of [_____]] [Btu/hr-ft2-F], Solar Heat Gain Coefficient (SHGC) maximum of [_____]. Color shall be [[green] [gray] [bronze] [blue] [_____]] [as shown in Section 09 06 90 COLOR SCHEDULE].

2.3 PLASTIC GLAZING

Plastic glazing shall have a U-factor maximum of [_____]Btu per square foot by hr by degree F. [Plastic glazing shall include a [0.63][1.26][_____] inch layer of aerogel between panels.]

2.3.1 Acrylic Sheet

ASTM D4802, [Type I, regular] [Type II, heat resistant,] [clear and smooth on both sides] [translucent, textured on both sides,] [gray tint,] [bronze tint,] ultraviolet stabilized, [scratch resistant,] [_____] [0.236] [_____] in. thick.

2.3.2 Polycarbonate Sheet

ANSI Z97.1, [Clear and smooth both sides] [Translucent, textured both sides] [Gray tint] [Bronze tint] [mar-resistant] [high abrasion resistant], ultraviolet stabilized, [_____] inch thick and listed in UL MEAPD as burglar resisting.

2.3.3 Extruded Polycarbonate Profiled Sheet

Provide [double] [triple] walled, surface treated for improved UV resistance, offering thermal efficiency and impact strength.

2.3.4 Bullet-Resistant Plastic Sheet

Cast acrylic sheet or mar-resistant polycarbonate sheet laminated with a special interlayer, and listed in UL 752 as bullet resisting, Class [I] [II] [III], [clear] [_____] in color. [Provide [_____].]

2.4 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.4.1 Putty and Glazing Compound

Glazing compound shall be as recommended by manufacturer for face-glazing metal sash. Putty shall be linseed oil type. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.4.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.4.3 Sealants

Provide elastomeric [and structural] sealants.

2.4.3.1 Elastomeric Sealant

ASTM C920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing [wood] [and] [metal] sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes[, with sealants used in manufacture of insulating glass units] [, and with plastic sheet]. Color of sealant shall be white.

2.4.3.2 Structural Sealant

ASTM C1184, Type S.

2.4.4 Joint Backer

Joint backer shall have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.4.5 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition. [Channels for bullet-resistant glass shall be synthetic rubber, ASTM C864, not less than 1/4 inch thick and sufficiently resilient to accommodate expansion and contraction while maintaining a vaportight seal between glass and frame.] [Channels shall be chemically compatible with plastic sheet.]

2.4.6 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D2287. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.4.7 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks shall be dense extruded type conforming to ASTM C509 and ASTM D395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (plus or minus 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer. Block color shall be black.

2.4.8 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as recommended by the manufacturer for the intended application.

2.4.8.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C509, Type 2, Option 1.

2.4.8.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C864, Option 1, Shore A durometer between 65 and 75.

2.4.8.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.4.9 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

[2.5 MIRROR ACCESSORIES

2.5.1 Mastic

Mastic for setting mirrors shall be a [polymer] [_____] type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.5.2 Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 1-1/4 by 1/4 by 1/4 inch continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

2.5.3 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

]PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face

puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Patterned Glass

Set glass with one patterned surface with smooth surface on the weather side. When used for interior partitions, place the patterned surface in same direction in all openings.

3.2.3 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

3.2.4 Installation of Wire Glass

Install glass for fire doors in accordance with installation requirements of NFPA 80.

3.2.5 Installation of Heat-Absorbing Glass

Glass shall have clean-cut, factory-fabricated edges. Field cutting will not be permitted.

3.2.6 Installation of Laminated Glass

Sashes which are to receive laminated glass shall be weeped to the outside to allow water drainage into the channel.

3.2.7 Plastic Sheet

Conform to manufacturer's recommendations for edge clearance, type of sealant and tape, and method of installation.

3.3 ADDITIONAL REQUIREMENTS FOR GLAZING CONTROL TOWER WINDOWS

3.3.1 Materials and Methods of Installation

Comply with the manufacturer's warranty and written instructions, except as indicated. Install units with the heat-absorbing glass to the exterior. Secure glass in place with bolts and spring clips. The minimum clearance between bolts and edge of glass unit shall be 3/16 inch. The glass shall be edged with 3/16 inch thick continuous neoprene, vinyl, or other approved material. Trim edging after installation. The channel shapes or strips shall be firmly held against the glass by the spring action of the extruded metal moldings. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, applicable glazing compound, and resilient channels or cemented-on materials shall be as recommended in the written instructions of the glass manufacturer, as approved.

3.3.2 Tolerances and Clearances of Units

Design to prevent the transfer of stress in the setting frames to the glass. Springing, twisting, or forcing of units during setting will not be permitted.

3.4 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted. [Clean plastic sheet in accordance with manufacturer's instructions.]

3.5 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Upon removal, separate protective materials for reuse or recycling. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

3.6 WASTE MANAGEMENT

Disposal and recycling of waste materials, including corrugated cardboard recycling, shall be in accordance with the Waste Management Plan.[Separate float glass and reuse or recycle.][Upon removal, separate protective materials and reuse or recycle.][Separate tempered glass for use as aggregate or nonstructural fill.] Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.

-- End of Section --

SECTION 08 81 00

GLAZING
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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2009; Errata 2010) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C1036	(2010; E 2012) Standard Specification for Flat Glass
ASTM C1048	(2012; E 2012) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C1172	(2009; E 2011) Standard Specification for Laminated Architectural Flat Glass
ASTM C1184	(2014) Standard Specification for Structural Silicone Sealants
ASTM C509	(2006; R 2011) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C864	(2005; R 2011) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D2287	(2012) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D395	(2014) Standard Test Methods for Rubber Property - Compression Set
ASTM D4802	(2010) Poly(Methyl Methacrylate) Acrylic

Plastic Sheet

ASTM E119 (2012a) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E1300 (2012a; E 2012) Determining Load Resistance of Glass in Buildings

ASTM E2129 (2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products

ASTM E2226 (2012) Standard Practice for Application of Hose Stream

ASTM E413 (2010) Rating Sound Insulation

ASTM E90 (2009) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual (2004) Glazing Manual

GANA Sealant Manual (2008) Sealant Manual

GANA Standards Manual (2001) Tempering Division's Engineering Standards Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-3001 (2001) Guidelines for Sloped Glazing

IGMA TM-3000 (1990; R 2004) North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use

IGMA TR-1200 (1983; R 2007) Guidelines for Commercial Insulating Glass Dimensional Tolerances

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (2014) Procedure for Determining Fenestration Product U-Factors

NFRC 200 (2014) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252 (2012) Standard Methods of Fire Tests of Door Assemblies

NFPA 257 (2012) Standard on Fire Test for Window and Glass Block Assemblies

NFPA 80	(2013) Standard for Fire Doors and Other Opening Protectives

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

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

16 CFR 1201	Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 752	(2005; Reprint Jul 2011) Standard for Bullet-Resisting Equipment
UL MEAPD	(2011) Mechanical Equipment and Associated Products Directory (online version is listed under Certifications at www.ul.com)

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

[Control Tower Insulating Glass]

[Control Tower Laminated Glass]

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

[SD-03 Product Data

Insulating Glass

Documentation for Energy Star qualifications.

Plastic Glazing

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

[Local/Regional Materials; (LEED NC)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Environmental Data]]

SD-04 Samples

Insulating Glass

Plastic Sheet

Glazing Compound

Glazing Tape

Sealant

Two 8 by 10 inch samples of each of the following: tinted glass, patterned glass, heat-absorbing glass, [_____] and insulating glass units.

Three samples of each indicated material. Samples of plastic sheets shall be minimum 5 by 7 inches.

[SD-07 Certificates

Insulating Glass

Plastic Glazing

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

[Control Tower Insulating Glass]

[Control Tower Laminated Glass]

Glazing Accessories

Certificates from the manufacturer attesting that the units meet the luminous and solar radiant transmission requirements for heat absorbing glass.]

SD-08 Manufacturer's Instructions

Setting and sealing materials

Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.[Include cleaning instructions for plastic sheets.]

SD-11 Closeout Submittals

Local/Regional Materials; LEED NC

LEED (tm) documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

[1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E1300.

]1.4 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [500][_____] mile radius from the project site, if available from a minimum of three sources.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Glazing materials may be locally available.]

1.6.2 Environmental Data

[Submit Table 1 of ASTM E2129 for the following products: [_____].]

1.7 WARRANTY

1.7.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government. [For control tower units, the warranty period shall be [10][_____] years; warranty shall be signed by the manufacturer.]

1.7.2 Warranty for Polycarbonate Sheet

For a 5-year period following acceptance of the work:

a. Warranty Type I, Class A (UV stabilized) sheets against breakage;

b. Warranty Type III (coated, mar-resistant) sheets against breakage and against coating delamination;

c. Warranty Type IV (coated sheet) against breakage and against yellowing;

d. Warranty extruded polycarbonate profile sheet against breakage.

For a 10-year period following acceptance of the work, warranty Type IV against yellowing and loss of light transmission.

[1.7.3 Monolithic Reflective Glass

Manufacturer shall warrant the monolithic reflective glass to be free of peeling or deteriorating of coating for a period of 10 years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

][1.7.4 Monolithic Opacified Spandrel

Manufacturer shall warrant the opacifier film on the spandrel to be free of peeling for a period of five years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

]PART 2 PRODUCTS

2.1 GLASS

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

[For interior glazing (i.e., pass and observation windows), 1/4 inch thick glass should be used.]

Type I, Class 1 (clear), Quality [q4 (A)] [q5 (B)]. Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not

over 45 square feet.

2.1.2 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - [clear] [tinted], Quality q3 - glazing select, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Color shall be [[gray] [bronze] [_____]].

2.1.3 Heat-Absorbing Glass

Type I, Class 2 (heat absorbing and light reducing), Quality [q3 (select)] [q4 (A)], [_____] inch thick, [blue][green] in color, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Color shall be [[gray] [bronze] [_____]] for 1/4 inch thickness.

2.1.4 Wired Glass

Glass for fire-rated windows shall be UL listed and shall be rated for [45] [20] minutes when tested in accordance with ASTM E2226. Wired glass shall be Type II flat type, Class [1 - translucent] [2 - tinted, heat-absorbing] [3 - tinted, light-reducing], Quality [q7 - decorative] [q8 - glazing], Form [1 - wired and polished both sides] [2 - patterned and wired], [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Wire mesh shall be polished stainless steel Mesh [1 - diamond] [2 - square] [3 - parallel]. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for [20] [45] minutes when tested in accordance with NFPA 257. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252.

2.1.5 Patterned Glass

Type II, Class 1 (translucent), Form 3 (patterned), Quality q7 (decorative), Finish [f1 (patterned one side)] [f2 (patterned two sides)], Pattern [p1 (linear)] [p2 (geometric)] [p3 (random)] [p4 (special)], [[_____] percent light transmittance, [_____] percent shading coefficient.] [1/8] [7/32] inch thick. [Provide [_____].]

2.1.6 Laminated Glass

[ASTM C1172, Kind LA fabricated from two nominal [1/8][_____] inchpieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass shall be laminated together with a minimum of 0.030 inchthick, clear polyvinyl butyral interlayer. The total thickness shall be nominally 1/4 [_____] inch.] [Fabricated from two pieces of Type I, Class 1, Quality q3 glass laminated together with a clear [_____] [0.015] inch thick polyvinyl butyral interlayer or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C1172. Color shall be [[clear] [gray] [bronze] [_____]] . The total thickness shall be nominally [_____] inch. [Provide [_____].]]

2.1.7 Bullet-Resisting Glass

Fabricated from Type I, Class 1, Quality q3 glass with polyvinyl butyral plastic interlayers between the layers of glass and listed by UL MEAPD as bullet resisting, with a power rating of [Medium--Small Arms] [High--Small Arms] [Super--Small Arms] [High--Rifle] in accordance with UL 752. Provide

[_____] [where indicated].

[2.1.8 Mirrors

2.1.8.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint , and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

]2.1.9 One-Way Vision Glass (Transparent Mirrors)

Type I, Class 1, Quality q1, 1/4 inch thick, coated on one face with a hard, adherent film of chromium or other approved coating of equal durability. Glass shall transmit not less than 5 percent or more than 11 percent of total incident visible light and shall reflect from the front surface of the coating not less than 45 percent of the total incident visible light. [Provide [_____].]

2.1.10 Tempered Glass

ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class [1 (transparent)] [2 (tinted heat absorbing)], Quality q3, [_____] inch thick, [_____] percent light transmittance, [_____] percent shading coefficient conforming to ASTM C1048 and GANA Standards Manual. Color shall be [[clear] [bronze] [gray] [_____]]. [Provide [_____]] [and wherever safety glazing material is indicated or specified].

2.1.11 Heat-Strengthened Glass

ASTM C1048, Kind HS (heat strengthened), Condition A (uncoated), Type I, Class [1 (clear)] [2 (tinted heat absorbing)], Quality q3, [_____] inch thick. [Provide [_____].]

2.1.12 Spandrel Glass

2.1.12.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass shall be Kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 2 surface, Quality q3 - glazing select, [_____] inchthick, conforming to ASTM C1048. Glass performance shall be R-Value/Winter Nighttime [_____], shading coefficient [_____]. Color shall be [_____].

2.1.12.2 Film-Opacified Spandrel Glass

Film-opacified spandrel glass shall be Kind HS heat-strengthened transparent flat type, Quality q3 - glazing select, Condition C glass with a polyester or polyethylene film 2 mils to 5 mils thick attached to No. 2

surface of a sputtered solar-reflective film, conforming to ASTM C1048. Film opacification shall be compatible to and specifically developed for application to solar reflective films. Glass performance shall be R-Value/Winter Nighttime [_____], shading coefficient [_____]. Color shall be [_____].

2.1.12.3 Spandrel Glass With Adhered Backing

ASTM C1048, Kind HS or FT, Condition B (ceramic coated), Type I, Quality q5, [_____] inch thick and shall pass the fallout resistance test specified in ASTM C1048. [Provide [_____].]

2.1.13 Fire/Safety Rated Glass

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a [20] [45] [60] [_____] minute rating when tested in accordance with ASTM E119. Glass shall be permanently labeled with appropriate markings.

2.1.14 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. [Color shall be [[gray] [bronze] [_____]] [as shown in Section 09 06 90 COLOR SCHEDULE].]

2.2 INSULATING GLASS UNITS

Two panes of glass separated by [a dehydrated [1/2 inch airspace, filled with argon][3/8 inch airspace, filled with krypton] gas,][[0.63][1.26][_____] inches of aerogel] and hermetically sealed. [Residential windows (including frames and glass) shall be Energy Star qualified products as appropriate to [Northern] [North/Central] [South/Central] [Southern] climate zone.] [Non-residential glazed systems (including frames and glass) shall be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of [_____] determined according to NFRC 200 procedures and a U-factor maximum of [_____] [Btu/hr-ft2-F] in accordance with NFRC 100.] Glazing shall meet or exceed a luminous efficacy of 1.0. Glazed panels shall be rated for not less than [26] [30] [35] [_____] Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413. Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be black, roll-formed, [thin-gauge, C-section steel] [steel-reinforced butyl rubber] [thermally broken aluminum] [polyurethane and silicon foams], with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

2.2.1 Buildings

Two panes of glass separated by a dehydrated airspace[, filled with argon gas][, filled with krypton gas,][, filled with aerogel] and hermetically sealed.

[Insulated glass units shall have a Solar Heat Gain Coefficient (SHGC) maximum of [_____]and a U-factor maximum of [_____] Btu per square foot by hr by degree F.]

[Glazing shall meet or exceed a luminous efficacy of 1.0.] [See section[s][_____] for energy performance requirements for glazed systems (glazing and frames).] [Glazed panels shall be rated for not less than [26] [30] [35] [_____] Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.]

Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be black, roll-formed,
[thin-gauge, C-section steel] [steel-reinforced butyl rubber] [thermally broken aluminum] [polyurethane and silicon foams], with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

The inner light shall be [ASTM C1172, clear annealed flat glass Type I, Class I, Quality q3] [ASTM C1036, Type I, Class 1, Quality q4, [_____] inch thick] [ASTM C1048, Grade B (fully tempered), Style I (uncoated), Type I, Class 1 (transparent), Quality q4, [_____] inch thick]. The outer light shall be [ASTM C1036, Type I, Class [1 (transparent)] [2 (tinted heat absorbing)], [2 (solar-reflective)], Quality q4, [_____] inch thick] [ASTM C1048, Grade B (fully tempered), Style I (uncoated), Type I, Class [1 (clear)] [2 (tinted heat absorbing)][solar-reflective], Quality q4, [_____] inch thick].

2.2.2 Control Towers

Control tower glass units shall be of sizes required to properly fit aluminum frames. Tolerances and clearances for units shall be designed to prevent the transfer of stress in aluminum frames to the glass. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, glazing sealants, and resilient channels or cemented-on-materials shall be of the type recommended in the glass manufacturer's approved written instructions. Edges and corners of units shall not be ground, nipped, cut, or fitted after leaving the factory.

2.2.2.1 Control Tower Insulating Glass

Insulating glass units for air traffic control towers shall meet the wind load design requirement of [_____] psi, as determined in accordance with ASCE 7. Insulating glass shall be Class A preassembled units of dual-seal construction consisting of two lites of glass separated by a dark bronze aluminum, steel, or stainless steel, spacer with desiccant and dehydrated space. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints, to completely seal the spacer periphery to eliminate moisture and hydrocarbon vapor transmission into airspace through corners. Primary seal shall be compressed polyisobutylene. Secondary seal shall be silicone. Insulating glass units shall be fabricated for use at an

elevation of [_____] feet above mean sea level and [_____] feet above grade. Within bottom 1/3 of one of the vertical edges of each unit, the manufacturer shall install an open 12 inch long capillary/breather tube for pressure equalization. The insulating glass units shall be free of parallax or optical distortions. The manufacturer's identifying label shall be permanently affixed to both exterior surfaces of the glass units. The insulating glass units shall be a total thickness of 1 inch consisting of two 1/4 inch thick panels and air space, or a total thickness of 1-1/4 inch consisting of two 3/8 inch thick panels and air space, or a total thickness of 1-1/2 inch consisting of two 1/2 inch thick panels and an air space, as required to meet the wind loads indicated. Glass type shall be as follows.

2.2.2.2 Control Tower Heat-Absorbing Insulating Glass

Heat-absorbing insulating glass shall consist of two glass panels separated by an air space and shall conform to ASTM C1036, Type I, transparent flat glass, Style A, Quality q3 - glazing select. Interior glass shall be Class 1-clear and exterior glass shall be Class 2-tinted green. Glass performance shall be minimum Visible Transmittance of [70.8] [_____] percent for each panel and R-Value of 1.85 for the unit.

2.2.2.3 Control Tower Clear Insulating Glass

Clear insulating glass shall consist of two float glass panels separated by an air space and shall conform to ASTM C1036, Type I transparent flat glass, Quality q3-glazing select. Interior glass and exterior glass shall be Class 1-clear. Glass performance shall be minimum Visible Transmittance of [87.3] [_____] percent for each panel and R-Value of 1.85 for each unit.

2.2.2.4 Control Tower Laminated Glass

Laminated glass units for air traffic control towers shall meet the wind load design requirement of [_____] psi, as determined in accordance with ASCE 7. ASTM C1172, Kind LA fabricated from two nominal 1/2 inchpieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass shall be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral interlayer or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C1172. The total thickness shall be nominally 1 inch. Color shall be [[clear] [gray] [bronze] [_____]]. [Provide [_____].]

2.2.3 Low Emissivity Insulating Glass

Interior and exterior glass panes for Low-E insulating units shall be Type I annealed flat glass, Class [1-clear] [2-tinted] with anti-reflective low-emissivity coating on [No. 2 surface (inside surface of exterior pane)][No. 3 surface (inside surface of interior pane)], Quality q3 - glazing select, conforming to ASTM C1036. Glass performance shall be U value maximum of [_____]] [Btu/hr-ft2-F], Solar Heat Gain Coefficient (SHGC) maximum of [_____]. Color shall be [[green] [gray] [bronze] [blue] [_____]] [as shown in Section 09 06 90 COLOR SCHEDULE].

2.3 PLASTIC GLAZING

Plastic glazing shall have a U-factor maximum of [_____]Btu per square foot by hr by degree F. [Plastic glazing shall include a [0.63][1.26][_____] inch layer of aerogel between panels.]

2.3.1 Acrylic Sheet

ASTM D4802, [Type I, regular] [Type II, heat resistant,] [clear and smooth on both sides] [translucent, textured on both sides,] [gray tint,] [bronze tint,] ultraviolet stabilized, [scratch resistant,] [_____] [0.236] [_____] in. thick.

2.3.2 Polycarbonate Sheet

ANSI Z97.1, [Clear and smooth both sides] [Translucent, textured both sides] [Gray tint] [Bronze tint] [mar-resistant] [high abrasion resistant], ultraviolet stabilized, [_____] inch thick and listed in UL MEAPD as burglar resisting.

2.3.3 Extruded Polycarbonate Profiled Sheet

Provide [double] [triple] walled, surface treated for improved UV resistance, offering thermal efficiency and impact strength.

2.3.4 Bullet-Resistant Plastic Sheet

Cast acrylic sheet or mar-resistant polycarbonate sheet laminated with a special interlayer, and listed in UL 752 as bullet resisting, Class [I] [II] [III], [clear] [_____] in color. [Provide [_____].]

2.4 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.4.1 Putty and Glazing Compound

Glazing compound shall be as recommended by manufacturer for face-glazing metal sash. Putty shall be linseed oil type. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.4.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.4.3 Sealants

Provide elastomeric [and structural] sealants.

2.4.3.1 Elastomeric Sealant

ASTM C920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing [wood] [and] [metal] sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes[, with sealants used in manufacture of insulating glass units] [, and with plastic sheet]. Color of sealant shall be white.

2.4.3.2 Structural Sealant

ASTM C1184, Type S.

2.4.4 Joint Backer

Joint backer shall have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.4.5 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition. [Channels for bullet-resistant glass shall be synthetic rubber, ASTM C864, not less than 1/4 inch thick and sufficiently resilient to accommodate expansion and contraction while maintaining a vaportight seal between glass and frame.] [Channels shall be chemically compatible with plastic sheet.]

2.4.6 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D2287. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.4.7 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks shall be dense extruded type conforming to ASTM C509 and ASTM D395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (plus or minus 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer. Block color shall be black.

2.4.8 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as recommended by the manufacturer for the intended application.

2.4.8.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C509, Type 2, Option 1.

2.4.8.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C864, Option 1, Shore A durometer between 65 and 75.

2.4.8.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.4.9 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

[2.5 MIRROR ACCESSORIES

2.5.1 Mastic

Mastic for setting mirrors shall be a [polymer] [_____] type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.5.2 Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 1-1/4 by 1/4 by 1/4 inch continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

2.5.3 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

]PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face

puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Patterned Glass

Set glass with one patterned surface with smooth surface on the weather side. When used for interior partitions, place the patterned surface in same direction in all openings.

3.2.3 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

3.2.4 Installation of Wire Glass

Install glass for fire doors in accordance with installation requirements of NFPA 80.

3.2.5 Installation of Heat-Absorbing Glass

Glass shall have clean-cut, factory-fabricated edges. Field cutting will not be permitted.

3.2.6 Installation of Laminated Glass

Sashes which are to receive laminated glass shall be weeped to the outside to allow water drainage into the channel.

3.2.7 Plastic Sheet

Conform to manufacturer's recommendations for edge clearance, type of sealant and tape, and method of installation.

3.3 ADDITIONAL REQUIREMENTS FOR GLAZING CONTROL TOWER WINDOWS

3.3.1 Materials and Methods of Installation

Comply with the manufacturer's warranty and written instructions, except as indicated. Install units with the heat-absorbing glass to the exterior. Secure glass in place with bolts and spring clips. The minimum clearance between bolts and edge of glass unit shall be 3/16 inch. The glass shall be edged with 3/16 inch thick continuous neoprene, vinyl, or other approved material. Trim edging after installation. The channel shapes or strips shall be firmly held against the glass by the spring action of the extruded metal moldings. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, applicable glazing compound, and resilient channels or cemented-on materials shall be as recommended in the written instructions of the glass manufacturer, as approved.

3.3.2 Tolerances and Clearances of Units

Design to prevent the transfer of stress in the setting frames to the glass. Springing, twisting, or forcing of units during setting will not be permitted.

3.4 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted. [Clean plastic sheet in accordance with manufacturer's instructions.]

3.5 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Upon removal, separate protective materials for reuse or recycling. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

3.6 WASTE MANAGEMENT

Disposal and recycling of waste materials, including corrugated cardboard recycling, shall be in accordance with the Waste Management Plan.[Separate float glass and reuse or recycle.][Upon removal, separate protective materials and reuse or recycle.][Separate tempered glass for use as aggregate or nonstructural fill.] Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.

-- End of Section --

SECTION 08 81 00

GLAZING
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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(2009; Errata 2010) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2010; Errata 2011; Supp 1 2013) Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C1036	(2010; E 2012) Standard Specification for Flat Glass
ASTM C1048	(2012; E 2012) Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C1172	(2009; E 2011) Standard Specification for Laminated Architectural Flat Glass
ASTM C1184	(2014) Standard Specification for Structural Silicone Sealants
ASTM C509	(2006; R 2011) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C864	(2005; R 2011) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D2287	(2012) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D395	(2014) Standard Test Methods for Rubber Property - Compression Set
ASTM D4802	(2010) Poly(Methyl Methacrylate) Acrylic

Plastic Sheet

ASTM E119 (2012a) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E1300 (2012a; E 2012) Determining Load Resistance of Glass in Buildings

ASTM E2129 (2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products

ASTM E2226 (2012) Standard Practice for Application of Hose Stream

ASTM E413 (2010) Rating Sound Insulation

ASTM E90 (2009) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual (2004) Glazing Manual

GANA Sealant Manual (2008) Sealant Manual

GANA Standards Manual (2001) Tempering Division's Engineering Standards Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-3001 (2001) Guidelines for Sloped Glazing

IGMA TM-3000 (1990; R 2004) North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use

IGMA TR-1200 (1983; R 2007) Guidelines for Commercial Insulating Glass Dimensional Tolerances

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (2014) Procedure for Determining Fenestration Product U-Factors

NFRC 200 (2014) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252 (2012) Standard Methods of Fire Tests of Door Assemblies

NFPA 257 (2012) Standard on Fire Test for Window and Glass Block Assemblies

NFPA 80	(2013) Standard for Fire Doors and Other Opening Protectives

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

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

16 CFR 1201	Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 752	(2005; Reprint Jul 2011) Standard for Bullet-Resisting Equipment
UL MEAPD	(2011) Mechanical Equipment and Associated Products Directory (online version is listed under Certifications at www.ul.com)

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

[Control Tower Insulating Glass]

[Control Tower Laminated Glass]

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

[SD-03 Product Data

Insulating Glass

Documentation for Energy Star qualifications.

Plastic Glazing

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

[Local/Regional Materials; (LEED NC)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Environmental Data]]

SD-04 Samples

Insulating Glass

Plastic Sheet

Glazing Compound

Glazing Tape

Sealant

Two 8 by 10 inch samples of each of the following: tinted glass, patterned glass, heat-absorbing glass, [_____] and insulating glass units.

Three samples of each indicated material. Samples of plastic sheets shall be minimum 5 by 7 inches.

[SD-07 Certificates

Insulating Glass

Plastic Glazing

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

[Control Tower Insulating Glass]

[Control Tower Laminated Glass]

Glazing Accessories

Certificates from the manufacturer attesting that the units meet the luminous and solar radiant transmission requirements for heat absorbing glass.]

SD-08 Manufacturer's Instructions

Setting and sealing materials

Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.[Include cleaning instructions for plastic sheets.]

SD-11 Closeout Submittals

Local/Regional Materials; LEED NC

LEED (tm) documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

[1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E1300.

]1.4 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [500][_____] mile radius from the project site, if available from a minimum of three sources.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Glazing materials may be locally available.]

1.6.2 Environmental Data

[Submit Table 1 of ASTM E2129 for the following products: [_____].]

1.7 WARRANTY

1.7.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government. [For control tower units, the warranty period shall be [10][_____] years; warranty shall be signed by the manufacturer.]

1.7.2 Warranty for Polycarbonate Sheet

For a 5-year period following acceptance of the work:

a. Warranty Type I, Class A (UV stabilized) sheets against breakage;

b. Warranty Type III (coated, mar-resistant) sheets against breakage and against coating delamination;

c. Warranty Type IV (coated sheet) against breakage and against yellowing;

d. Warranty extruded polycarbonate profile sheet against breakage.

For a 10-year period following acceptance of the work, warranty Type IV against yellowing and loss of light transmission.

[1.7.3 Monolithic Reflective Glass

Manufacturer shall warrant the monolithic reflective glass to be free of peeling or deteriorating of coating for a period of 10 years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

][1.7.4 Monolithic Opacified Spandrel

Manufacturer shall warrant the opacifier film on the spandrel to be free of peeling for a period of five years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

]PART 2 PRODUCTS

2.1 GLASS

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

[For interior glazing (i.e., pass and observation windows), 1/4 inch thick glass should be used.]

Type I, Class 1 (clear), Quality [q4 (A)] [q5 (B)]. Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not

over 45 square feet.

2.1.2 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - [clear] [tinted], Quality q3 - glazing select, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Color shall be [[gray] [bronze] [_____]].

2.1.3 Heat-Absorbing Glass

Type I, Class 2 (heat absorbing and light reducing), Quality [q3 (select)] [q4 (A)], [_____] inch thick, [blue][green] in color, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Color shall be [[gray] [bronze] [_____]] for 1/4 inch thickness.

2.1.4 Wired Glass

Glass for fire-rated windows shall be UL listed and shall be rated for [45] [20] minutes when tested in accordance with ASTM E2226. Wired glass shall be Type II flat type, Class [1 - translucent] [2 - tinted, heat-absorbing] [3 - tinted, light-reducing], Quality [q7 - decorative] [q8 - glazing], Form [1 - wired and polished both sides] [2 - patterned and wired], [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. Wire mesh shall be polished stainless steel Mesh [1 - diamond] [2 - square] [3 - parallel]. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for [20] [45] minutes when tested in accordance with NFPA 257. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252.

2.1.5 Patterned Glass

Type II, Class 1 (translucent), Form 3 (patterned), Quality q7 (decorative), Finish [f1 (patterned one side)] [f2 (patterned two sides)], Pattern [p1 (linear)] [p2 (geometric)] [p3 (random)] [p4 (special)], [[_____] percent light transmittance, [_____] percent shading coefficient.] [1/8] [7/32] inch thick. [Provide [_____].]

2.1.6 Laminated Glass

[ASTM C1172, Kind LA fabricated from two nominal [1/8][_____] inchpieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass shall be laminated together with a minimum of 0.030 inchthick, clear polyvinyl butyral interlayer. The total thickness shall be nominally 1/4 [_____] inch.] [Fabricated from two pieces of Type I, Class 1, Quality q3 glass laminated together with a clear [_____] [0.015] inch thick polyvinyl butyral interlayer or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C1172. Color shall be [[clear] [gray] [bronze] [_____]] . The total thickness shall be nominally [_____] inch. [Provide [_____].]]

2.1.7 Bullet-Resisting Glass

Fabricated from Type I, Class 1, Quality q3 glass with polyvinyl butyral plastic interlayers between the layers of glass and listed by UL MEAPD as bullet resisting, with a power rating of [Medium--Small Arms] [High--Small Arms] [Super--Small Arms] [High--Rifle] in accordance with UL 752. Provide

[_____] [where indicated].

[2.1.8 Mirrors

2.1.8.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint , and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

]2.1.9 One-Way Vision Glass (Transparent Mirrors)

Type I, Class 1, Quality q1, 1/4 inch thick, coated on one face with a hard, adherent film of chromium or other approved coating of equal durability. Glass shall transmit not less than 5 percent or more than 11 percent of total incident visible light and shall reflect from the front surface of the coating not less than 45 percent of the total incident visible light. [Provide [_____].]

2.1.10 Tempered Glass

ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class [1 (transparent)] [2 (tinted heat absorbing)], Quality q3, [_____] inch thick, [_____] percent light transmittance, [_____] percent shading coefficient conforming to ASTM C1048 and GANA Standards Manual. Color shall be [[clear] [bronze] [gray] [_____]]. [Provide [_____]] [and wherever safety glazing material is indicated or specified].

2.1.11 Heat-Strengthened Glass

ASTM C1048, Kind HS (heat strengthened), Condition A (uncoated), Type I, Class [1 (clear)] [2 (tinted heat absorbing)], Quality q3, [_____] inch thick. [Provide [_____].]

2.1.12 Spandrel Glass

2.1.12.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass shall be Kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 2 surface, Quality q3 - glazing select, [_____] inchthick, conforming to ASTM C1048. Glass performance shall be R-Value/Winter Nighttime [_____], shading coefficient [_____]. Color shall be [_____].

2.1.12.2 Film-Opacified Spandrel Glass

Film-opacified spandrel glass shall be Kind HS heat-strengthened transparent flat type, Quality q3 - glazing select, Condition C glass with a polyester or polyethylene film 2 mils to 5 mils thick attached to No. 2

surface of a sputtered solar-reflective film, conforming to ASTM C1048. Film opacification shall be compatible to and specifically developed for application to solar reflective films. Glass performance shall be R-Value/Winter Nighttime [_____], shading coefficient [_____]. Color shall be [_____].

2.1.12.3 Spandrel Glass With Adhered Backing

ASTM C1048, Kind HS or FT, Condition B (ceramic coated), Type I, Quality q5, [_____] inch thick and shall pass the fallout resistance test specified in ASTM C1048. [Provide [_____].]

2.1.13 Fire/Safety Rated Glass

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a [20] [45] [60] [_____] minute rating when tested in accordance with ASTM E119. Glass shall be permanently labeled with appropriate markings.

2.1.14 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to ASTM C1036. [Color shall be [[gray] [bronze] [_____]] [as shown in Section 09 06 90 COLOR SCHEDULE].]

2.2 INSULATING GLASS UNITS

Two panes of glass separated by [a dehydrated [1/2 inch airspace, filled with argon][3/8 inch airspace, filled with krypton] gas,][[0.63][1.26][_____] inches of aerogel] and hermetically sealed. [Residential windows (including frames and glass) shall be Energy Star qualified products as appropriate to [Northern] [North/Central] [South/Central] [Southern] climate zone.] [Non-residential glazed systems (including frames and glass) shall be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of [_____] determined according to NFRC 200 procedures and a U-factor maximum of [_____] [Btu/hr-ft2-F] in accordance with NFRC 100.] Glazing shall meet or exceed a luminous efficacy of 1.0. Glazed panels shall be rated for not less than [26] [30] [35] [_____] Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413. Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be black, roll-formed, [thin-gauge, C-section steel] [steel-reinforced butyl rubber] [thermally broken aluminum] [polyurethane and silicon foams], with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

2.2.1 Buildings

Two panes of glass separated by a dehydrated airspace[, filled with argon gas][, filled with krypton gas,][, filled with aerogel] and hermetically sealed.

[Insulated glass units shall have a Solar Heat Gain Coefficient (SHGC) maximum of [_____]and a U-factor maximum of [_____] Btu per square foot by hr by degree F.]

[Glazing shall meet or exceed a luminous efficacy of 1.0.] [See section[s][_____] for energy performance requirements for glazed systems (glazing and frames).] [Glazed panels shall be rated for not less than [26] [30] [35] [_____] Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.]

Dimensional tolerances shall be as specified in IGMA TR-1200. Spacer shall be black, roll-formed,
[thin-gauge, C-section steel] [steel-reinforced butyl rubber] [thermally broken aluminum] [polyurethane and silicon foams], with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

The inner light shall be [ASTM C1172, clear annealed flat glass Type I, Class I, Quality q3] [ASTM C1036, Type I, Class 1, Quality q4, [_____] inch thick] [ASTM C1048, Grade B (fully tempered), Style I (uncoated), Type I, Class 1 (transparent), Quality q4, [_____] inch thick]. The outer light shall be [ASTM C1036, Type I, Class [1 (transparent)] [2 (tinted heat absorbing)], [2 (solar-reflective)], Quality q4, [_____] inch thick] [ASTM C1048, Grade B (fully tempered), Style I (uncoated), Type I, Class [1 (clear)] [2 (tinted heat absorbing)][solar-reflective], Quality q4, [_____] inch thick].

2.2.2 Control Towers

Control tower glass units shall be of sizes required to properly fit aluminum frames. Tolerances and clearances for units shall be designed to prevent the transfer of stress in aluminum frames to the glass. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, glazing sealants, and resilient channels or cemented-on-materials shall be of the type recommended in the glass manufacturer's approved written instructions. Edges and corners of units shall not be ground, nipped, cut, or fitted after leaving the factory.

2.2.2.1 Control Tower Insulating Glass

Insulating glass units for air traffic control towers shall meet the wind load design requirement of [_____] psi, as determined in accordance with ASCE 7. Insulating glass shall be Class A preassembled units of dual-seal construction consisting of two lites of glass separated by a dark bronze aluminum, steel, or stainless steel, spacer with desiccant and dehydrated space. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints, to completely seal the spacer periphery to eliminate moisture and hydrocarbon vapor transmission into airspace through corners. Primary seal shall be compressed polyisobutylene. Secondary seal shall be silicone. Insulating glass units shall be fabricated for use at an

elevation of [_____] feet above mean sea level and [_____] feet above grade. Within bottom 1/3 of one of the vertical edges of each unit, the manufacturer shall install an open 12 inch long capillary/breather tube for pressure equalization. The insulating glass units shall be free of parallax or optical distortions. The manufacturer's identifying label shall be permanently affixed to both exterior surfaces of the glass units. The insulating glass units shall be a total thickness of 1 inch consisting of two 1/4 inch thick panels and air space, or a total thickness of 1-1/4 inch consisting of two 3/8 inch thick panels and air space, or a total thickness of 1-1/2 inch consisting of two 1/2 inch thick panels and an air space, as required to meet the wind loads indicated. Glass type shall be as follows.

2.2.2.2 Control Tower Heat-Absorbing Insulating Glass

Heat-absorbing insulating glass shall consist of two glass panels separated by an air space and shall conform to ASTM C1036, Type I, transparent flat glass, Style A, Quality q3 - glazing select. Interior glass shall be Class 1-clear and exterior glass shall be Class 2-tinted green. Glass performance shall be minimum Visible Transmittance of [70.8] [_____] percent for each panel and R-Value of 1.85 for the unit.

2.2.2.3 Control Tower Clear Insulating Glass

Clear insulating glass shall consist of two float glass panels separated by an air space and shall conform to ASTM C1036, Type I transparent flat glass, Quality q3-glazing select. Interior glass and exterior glass shall be Class 1-clear. Glass performance shall be minimum Visible Transmittance of [87.3] [_____] percent for each panel and R-Value of 1.85 for each unit.

2.2.2.4 Control Tower Laminated Glass

Laminated glass units for air traffic control towers shall meet the wind load design requirement of [_____] psi, as determined in accordance with ASCE 7. ASTM C1172, Kind LA fabricated from two nominal 1/2 inchpieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass shall be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral interlayer or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C1172. The total thickness shall be nominally 1 inch. Color shall be [[clear] [gray] [bronze] [_____]]. [Provide [_____].]

2.2.3 Low Emissivity Insulating Glass

Interior and exterior glass panes for Low-E insulating units shall be Type I annealed flat glass, Class [1-clear] [2-tinted] with anti-reflective low-emissivity coating on [No. 2 surface (inside surface of exterior pane)][No. 3 surface (inside surface of interior pane)], Quality q3 - glazing select, conforming to ASTM C1036. Glass performance shall be U value maximum of [_____]] [Btu/hr-ft2-F], Solar Heat Gain Coefficient (SHGC) maximum of [_____]. Color shall be [[green] [gray] [bronze] [blue] [_____]] [as shown in Section 09 06 90 COLOR SCHEDULE].

2.3 PLASTIC GLAZING

Plastic glazing shall have a U-factor maximum of [_____]Btu per square foot by hr by degree F. [Plastic glazing shall include a [0.63][1.26][_____] inch layer of aerogel between panels.]

2.3.1 Acrylic Sheet

ASTM D4802, [Type I, regular] [Type II, heat resistant,] [clear and smooth on both sides] [translucent, textured on both sides,] [gray tint,] [bronze tint,] ultraviolet stabilized, [scratch resistant,] [_____] [0.236] [_____] in. thick.

2.3.2 Polycarbonate Sheet

ANSI Z97.1, [Clear and smooth both sides] [Translucent, textured both sides] [Gray tint] [Bronze tint] [mar-resistant] [high abrasion resistant], ultraviolet stabilized, [_____] inch thick and listed in UL MEAPD as burglar resisting.

2.3.3 Extruded Polycarbonate Profiled Sheet

Provide [double] [triple] walled, surface treated for improved UV resistance, offering thermal efficiency and impact strength.

2.3.4 Bullet-Resistant Plastic Sheet

Cast acrylic sheet or mar-resistant polycarbonate sheet laminated with a special interlayer, and listed in UL 752 as bullet resisting, Class [I] [II] [III], [clear] [_____] in color. [Provide [_____].]

2.4 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.4.1 Putty and Glazing Compound

Glazing compound shall be as recommended by manufacturer for face-glazing metal sash. Putty shall be linseed oil type. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.4.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.4.3 Sealants

Provide elastomeric [and structural] sealants.

2.4.3.1 Elastomeric Sealant

ASTM C920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing [wood] [and] [metal] sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes[, with sealants used in manufacture of insulating glass units] [, and with plastic sheet]. Color of sealant shall be white.

2.4.3.2 Structural Sealant

ASTM C1184, Type S.

2.4.4 Joint Backer

Joint backer shall have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.4.5 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition. [Channels for bullet-resistant glass shall be synthetic rubber, ASTM C864, not less than 1/4 inch thick and sufficiently resilient to accommodate expansion and contraction while maintaining a vaportight seal between glass and frame.] [Channels shall be chemically compatible with plastic sheet.]

2.4.6 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D2287. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.4.7 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks shall be dense extruded type conforming to ASTM C509 and ASTM D395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (plus or minus 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer. Block color shall be black.

2.4.8 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as recommended by the manufacturer for the intended application.

2.4.8.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C509, Type 2, Option 1.

2.4.8.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C864, Option 1, Shore A durometer between 65 and 75.

2.4.8.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.4.9 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

[2.5 MIRROR ACCESSORIES

2.5.1 Mastic

Mastic for setting mirrors shall be a [polymer] [_____] type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.5.2 Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 1-1/4 by 1/4 by 1/4 inch continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

2.5.3 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

]PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face

puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Patterned Glass

Set glass with one patterned surface with smooth surface on the weather side. When used for interior partitions, place the patterned surface in same direction in all openings.

3.2.3 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

3.2.4 Installation of Wire Glass

Install glass for fire doors in accordance with installation requirements of NFPA 80.

3.2.5 Installation of Heat-Absorbing Glass

Glass shall have clean-cut, factory-fabricated edges. Field cutting will not be permitted.

3.2.6 Installation of Laminated Glass

Sashes which are to receive laminated glass shall be weeped to the outside to allow water drainage into the channel.

3.2.7 Plastic Sheet

Conform to manufacturer's recommendations for edge clearance, type of sealant and tape, and method of installation.

3.3 ADDITIONAL REQUIREMENTS FOR GLAZING CONTROL TOWER WINDOWS

3.3.1 Materials and Methods of Installation

Comply with the manufacturer's warranty and written instructions, except as indicated. Install units with the heat-absorbing glass to the exterior. Secure glass in place with bolts and spring clips. The minimum clearance between bolts and edge of glass unit shall be 3/16 inch. The glass shall be edged with 3/16 inch thick continuous neoprene, vinyl, or other approved material. Trim edging after installation. The channel shapes or strips shall be firmly held against the glass by the spring action of the extruded metal moldings. Resilient setting blocks, spacer strips, clips, bolts, washers, angles, applicable glazing compound, and resilient channels or cemented-on materials shall be as recommended in the written instructions of the glass manufacturer, as approved.

3.3.2 Tolerances and Clearances of Units

Design to prevent the transfer of stress in the setting frames to the glass. Springing, twisting, or forcing of units during setting will not be permitted.

3.4 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted. [Clean plastic sheet in accordance with manufacturer's instructions.]

3.5 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Upon removal, separate protective materials for reuse or recycling. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

3.6 WASTE MANAGEMENT

Disposal and recycling of waste materials, including corrugated cardboard recycling, shall be in accordance with the Waste Management Plan.[Separate float glass and reuse or recycle.][Upon removal, separate protective materials and reuse or recycle.][Separate tempered glass for use as aggregate or nonstructural fill.] Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.

-- End of Section --

SECTION 09 29 00

GYPSUM BOARD
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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992; Reaffirmed 2005) Specifications for Interior Installation of Cementitious Backer Units

ASTM INTERNATIONAL (ASTM)

ASTM C1002	(2007; R 2013) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C1047	(2014a) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1177/C1177M	(2013) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C1178/C1178M	(2013) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C1396/C1396M	(2014) Standard Specification for Gypsum Board
ASTM C1629/C1629M	(2014) Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
ASTM C475/C475M	(2012) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C514	(2004; E 2009; R 2009) Standard Specification for Nails for the Application of Gypsum Board
ASTM C557	(2003; E 2009; R 2009) Adhesives for Fastening Gypsum Wallboard to Wood Framing
ASTM C840	(2013) Application and Finishing of Gypsum Board

ASTM C954	(2011) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D226/D226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D2394	(2005; R 2011) Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D412	(2006a; R 2013) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D5420	(2010) Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Strike Impacted by a Falling Weight (Gardner Impact)
ASTM D624	(2000; R 2012) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM E2129	(2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E695	(2003; R 2009) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board Finish
GA 216	(2010) Application and Finishing of Gypsum Panel Products
GA 224	(2008) Installation of Predecorated Gypsum Board
GA 253	(2012) Application of Gypsum Sheathing
GA 600	(2009) Fire Resistance Design Manual

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

UL ENVIRONMENT (ULE)

ULE Greenguard	UL Greenguard Certification Program

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2012) Fire Resistance 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.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cementitious backer units

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board

Glass Mat Covered or Reinforced Gypsum Sheathing

Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Impact Resistant Gypsum Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

Certification

Gypsum Board; (LEED NC)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

[Adhesives; (LEED NC)
Joint Treatment Materials

Submit manufacturer's product data, indicating VOC content.]

[Local/Regional Materials; (LEED NC)

Documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Environmental Data]

SD-04 Samples

Predecorated gypsum board[; G][; G, [_____]]

Submit for each color and pattern of predecorated gypsum board. Where colors are not indicated, submit color selection samples of not less than eight of the manufacturer's standard colors.

SD-07 Certificates

Asbestos Free Materials[; G][; G, [_____]]

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer maintenance instructions

Waste Management

SD-11 Closeout Submittals

Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Gypsum Board; (LEED)

LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Adhesives; (LEED)

LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED

Documentation Notebook.

1.3 [SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified in accordance with ULE Greenguard[Gold], SCS Scientific Certification Systems Indoor Advantage[Gold]or equal. Certification shall be performed annually and shall be current.]

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.4.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Gypsum wallboard shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants, including [_____]. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.4.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.5 ENVIRONMENTAL CONDITIONS

1.5.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.5.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.5.3 Temporary Ventilation

Provide temporary ventilation for work of this section.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Local/Regional Materials

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [500][_____] mile radius from the project site, if

available from a minimum of three sources.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Gypsum board materials may be locally available.]

1.6.2 Environmental Data

[Submit Table 1 of ASTM E2129 for the following products: [_____].]

1.7 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of [3] [_____] years of documented successful experience.

1.8 SCHEDULING

[The gypsum wallboard shall be taped, spackled and primed before the installation of the highly-emitting materials, including [_____].] [The gypsum wallboard shall be installed after the installation and ventilation period of the highly-emitting materials, including [_____].]

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only. Submit Material Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

2.1.1 Gypsum Board

ASTM C1396/C1396M. [Gypsum board shall contain a minimum of [5][10][_____] percent post-consumer recycled content, or a minimum of [20][40][_____] percent post-industrial recycled content.] [Paper facings shall contain [100][_____] percent post-consumer recycled paper content. Gypsum cores shall contain a minimum of [95][_____] percent post-industrial recycled gypsum content.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. Gypsum board may contain post-consumer or post-industrial recycled content.]

2.1.1.1 Regular

48 inch wide, [1/2] [5/8] inch thick, [tapered][, tapered and featured] edges. [Provide tapered and featured edge gypsum board [in Rooms [_____]] [as indicated].]

2.1.1.2 Foil-Backed

48 inch wide, [1/2] [5/8] inch thick, [tapered] [tapered and featured] edges.

2.1.1.3 Type X (Special Fire-Resistant)

48 inch wide, [1/2] [5/8] inch thick, [tapered] [tapered and featured] edges.

2.1.2 Gypsum Backing Board

ASTM C1396/C1396M, gypsum backing board shall be used as a base in a multilayer system.

2.1.2.1 Regular

48 inch wide, [1/2] [5/8] inch thick, square edges.

2.1.2.2 Foil-Backed

48 inch wide, [1/2] [5/8] inch thick, square edges.

2.1.2.3 Type X (Special Fire-Resistant)

48 inch wide, [1/2] [5/8] inch thick, square edges.

2.1.3 Regular Water-Resistant Gypsum Backing Board

ASTM C1396/C1396M

2.1.3.1 Regular

48 inch wide, [1/2] [5/8] inch thick, tapered edges.

2.1.3.2 Type X (Special Fire-Resistant)

48 inch wide, [1/2] [5/8] inch thick, tapered edges.

2.1.4 Glass Mat Water-Resistant Gypsum Tile Backing Board

ASTM C1178/C1178M

2.1.4.1 Regular

48 inch wide, [1/2] [5/8] inch thick, square edges.

2.1.4.2 Type X (Special Fire-Resistant)

48 inch wide, [1/2] [5/8] inch thick, square edges.

2.1.5 [Glass Mat Covered or Reinforced Gypsum Sheathing

Exceeds physical properties of ASTM C1396/C1396M and ASTM C1177/C1177M. Provide [1/2][5/8] inch, gypsum sheathing. Provide gypsum board of with a noncombustible water-resistant core, with glass mat surfaces embedded to the gypsum core or reinforcing embedded throughout the gypsum core. Warrant gypsum sheathing board for at least twelve months against delamination due to direct weather exposure. Provide continuous, asphalt impregnated, building felt to cover exterior face of sheathing. Seal [all joints, seams, and penetrations with compatible sealant.]

2.1.5.1 [Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Provide sealant compatible with gypsum sheathing, rubber washers for masonry veneer anchors, and other associated cavity wall components such as anchors and through wall flashing. Provide sealants for gypsum sheathing board edge seams and veneer anchor penetrations recommended by the gypsum sheathing manufacturer and have the following performance requirements:

a. ASTM D412: Tensile Strength, 80 psi
b. ASTM D412: Ultimate Tensile Strength (maximum elongation), 170 psi
c. ASTM D624: Tear Strength, dieB, 27 ppi
d. ASTM D1149: Joint Movement Capability after 14 Days cure, plus or minus 50 percent.

]]2.1.6 [Impact Resistant Gypsum Board

48 inchwide, 5/8 inch thick, tapered edges. Reinforced gypsum panel with imbedded fiber mesh or lexan backing testing in accordance with the following tests. Hard body impact test must attain a Level 2 performance in accordance with ASTM C1629/C1629M. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Impact resistant gypsum board, when tested in accordance with ASTM E84, have [a flame spread rating of 25 or less and a smoke developed rating of 50 or less for [_____]] [and] [a flame spread rating of 75 or less and a smoke developed rating of 100 or less for [_____]].

2.1.6.1 Structural Failure Test

ASTM E695 or ASTM D2394 for structural failure (drop penetration). ASTM E695 using a 60 lb sand filled leather bag, resisting no less than 300 ft. lb. cumulative impact energy before failure or ASTM D2394 using 5.5 inch hemispherical projectile resisting no less than 264 ft. lb. before failure. Provide test specimen stud spacing a minimum 16 inch on center.

2.1.6.2 Indentation Test

ASTM D5420 or ASTM D1037 for indentation resistance. ASTM D5420 using a 32 oz weight with a 5/8 inch hemispherical impacting head dropped once 3 feet creating not more than 0.137 inch indentation or ASTM D1037 using no less than 470 lb weight applied to the 0.438 inch diameter ball to create not more than a 0.0197 inch indentation depth.

]2.1.7 Predecorated Gypsum Board

ASTM C1396/C1396M, [regular] [Type X] gypsum board, 48 inch wide, [1/2] [5/8] inch thick, with a decorative wall covering (Class I) [or coating (Class II)] applied in-plant by the gypsum board manufacturer. The color [and pattern] of wall covering shall be [_____] [as selected]. Provide [_____] color [and pattern] wall covering selected. [Furnish gypsum board with square edges, and a slight bevel to produce a shallow vee joint. Wrap all coverings around edges.] Furnish a predecorated gypsum board with [a flame spread rating of 25 or less and a smoke developed rating of 50 or less for [_____]] [and] [a flame spread rating of 75 or less and a smoke developed rating of 100 or less for [_____]].

2.1.8 Cementitious Backer Units

In accordance with the Tile Council of America (TCA) Handbook.

2.1.9 Joint Treatment Materials

ASTM C475/C475M. [Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.]

2.1.9.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.9.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.9.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.9.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.9.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.10 Fasteners

2.1.10.1 Nails

ASTM C514. [For predecorated gypsum board provide special nails with factory coated heads of color to match wall covering materials as recommended by the predecorated gypsum board manufacturer.]

2.1.10.2 Screws

ASTM C1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.10.3 Staples

No. 16 USS gageflattened galvanized wire staples with 7/16 inch wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

Length of Legs	Thickness of Gypsum Board
1-1/8 inches	1/2 inch
1-1/4 inches	5/8 inch

2.1.11 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.[Adhesive shall contain a maximum VOC content of 50 grams per liter.][Adhesive must meet the requirements of LEED low emitting materials credit.]

2.1.11.1 Adhesive for Fastening Gypsum Board to Metal Framing

[Not permitted.][Type recommended by gypsum board manufacturer.]

2.1.11.2 Adhesive for Fastening Gypsum Board to Wood Framing

[Not permitted.][ASTM C557.]

2.1.11.3 Adhesive for Laminating

[Not permitted.][Adhesive attachment is not permitted for multi-layer gypsum boards. For laminating gypsum studs to face panels, provide adhesive recommended by gypsum board manufacturer.]

2.1.12 Gypsum Studs

Provide one inch minimum thickness and 6 inch minimum width. Studs may be of one inch thick gypsum board or multilayers fastened to required thickness. Conform to ASTM C1396/C1396M for material.

2.1.13 Shaftwall Liner Panel

ASTM C1396/C1396M. Conform to the UL Fire Resistance for the Design Numbers(s) indicated for shaftwall liner panels. Manufacture liner panel for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, [1"] [3/4"] thick, by 24" wide.

2.1.14 Accessories

ASTM C1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials. [For predecorated gypsum board provide prefinished metal or plastic trim to match predecorated gypsum board.]

2.1.15 Asphalt Impregnated Building Felt

Provide a 15 lb asphalt moisture barrier over gypsum sheathing. Conforming to ASTM D226/D226M Type 1 (No. 15) for asphalt impregnated building felt.

2.1.16 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 [Gypsum Board] [and] [Framing]

Verify that surfaces of [gypsum board] [and] [framing] to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.1.3 [Masonry] [and] [Concrete] Walls

Verify that surfaces of [masonry] [and] [concrete] walls to receive gypsum board applied with adhesive are dry, free of dust, oil, form release agents, protrusions and voids, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may [not]be bonded together with an adhesive[, except where prohibited by fire rating(s)]. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Minimize framing by floating corners with single studs and drywall clips. [Install [5/8 inch][_____] gypsum or [1/2 inch][_____] ceiling board over framing at [24 inches][_____] on center.] Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Single-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C840, System I or GA 216.

3.2.2 Application of Two-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C840, System II or GA 216.

3.2.3 Adhesive Nail-On Application to Wood Framing

Apply in accordance with ASTM C840, System III or GA 216. This method may be used in lieu of ASTM C840, System I at the option of the Contractor.

3.2.4 Semi-Solid Gypsum Board Partitions

Provide in accordance with ASTM C840, System IV or GA 216 .

3.2.5 Solid Gypsum Board Partitions

Provide in accordance with ASTM C840, System V or GA 216.

3.2.6 Adhesive Application to Interior Masonry or Concrete Walls

Apply in accordance with ASTM C840, System VI or GA 216.

3.2.7 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

3.2.8 Arches and Bending Radii

Apply gypsum board in accordance with ASTM C840, System IX or GA 216.

3.2.9 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply glass mat water-resistant gypsum tile backing board [or water-resistant gypsum backing board] in accordance with ASTM C840, System X or GA 216.

3.2.10 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with ASTM C840, System XI or GA 216.

3.2.11 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

Apply gypsum sheathing in accordance to gypsum association publications GA 253. Follow gypsum sheathing manufacturer's requirements of design details for joints and fasteners and be properly installed to protect the substrate from moisture intrusion. Do not leave exposed surfaces of the gypsum sheathing beyond the manufacturer's recommendation without a weather barrier cladding. Provide continuous asphalt impregnated building felt over sheathing surface in shingle fashion with edges and ends lapped a minimum of 6 inch. Property flash the openings. [Seal all joints, seams, and penetrations with a compatible silicone sealant.]

3.2.12 Floating Interior Angles

Minimize framing by floating corners with single studs and drywall clips. Locate the attachment fasteners adjacent to ceiling and wall intersections in accordance with ASTM C840, System XII or GA 216, for [single-ply] [and] [two-ply] applications of gypsum board to wood framing.

3.2.13 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA 216. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

3.2.14 Application of Foil-Backed Gypsum Board

Apply foil-backed gypsum board in accordance with ASTM C840, System XIV or GA 216.

3.2.15 Application of Predecorated Gypsum Board

Apply predecorated gypsum board in accordance with GA 224. Attach predecorated gypsum board with adhesive and fasteners as recommended by the

manufacturer. Conceal fasteners in the finished work.

3.2.16 Application of Impact Resistant Gypsum Board

Apply in accordance with applicable system of ASTM C840 as specified or GA 216. Follow manufacturers written instructions on how to cut, drill and attach board.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. Place a 15 lb asphalt impregnated, continuous felt paper membrane behind cementitious backer units, between backer units and studs or base layer of gypsum board. Place membrane with a minimum 6 inch overlap of sheets laid shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish water resistant gypsum backing board, ASTM C1396/C1396M, to receive ceramic tile to Level 2 in accordance with GA 214. Finish walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.4.2 [Metal Trim for Predecorated Gypsum Board

Finish edges, ends, and joints of predecorated gypsum board, except prefinished vee joints and monolithic type joints, with metal or plastic trim selected to match the gypsum board finish.

]3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.5.1 [Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply silicone sealant in a 3/8 inch bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. Do not place [construction and materials behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.]

]3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners,[wall[and ceiling] framing] in accordance with the specifications contained in [UL Fire Resistance for the Design Number(s) indicated], [or] [GA 600 for the File Number(s) indicated]. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes. [Remove predecorated gypsum board which cannot be restored to like-new condition. Provide new predecorated gypsum board.]

3.8 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

3.9 WASTE MANAGEMENT

As specified in Waste Management Plan and as follows. Separate clean waste gypsum products from contaminants. Do not include wood, plastic, metal, asphalt-impregnated gypsum board, or any gypsum board coated with glass fiber, vinyl, decorative paper, or other finish. Place in designated area and protect from moisture and contamination. Coordinate with Section 32 05 33 LANDSCAPE ESTABLISHMENT to identify requirements for gypsum soil amendment and to prepare scrap gypsum board for use as soil amendment.

[Identify manufacturer's policy for collection or return of remaining [construction scrap,] [unused material,] [demolition scrap,] and [packaging material]. Institute demolition and construction recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials.]

-- End of Section --

SECTION 09 30 13

CERAMIC TILING
11/13

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 A137.1	(2012) American National Standards Specifications for Ceramic Tile
ANSI A137.2	(2012) American National Standards Specifications for Glass Tile

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2013) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C1026	(2013) Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C1027	(2009) Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C1178/C1178M	(2013) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C144	(2011) Standard Specification for Aggregate for Masonry Mortar
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C206	(2003; R 2009) Standard Specification for Finishing Hydrated Lime
ASTM C207	(2006; R 2011) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C241/C241M	(2013) Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C33/C33M	(2013) Standard Specification for Concrete Aggregates

ASTM C373	(2014) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C648	(2004; R 2009) Breaking Strength of Ceramic Tile
ASTM C847	(2014) Standard Specification for Metal Lath
ASTM D2103	(2010) Standard Specification for Polyethylene Film and Sheeting
ASTM D226/D226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D4068	(2009) Chlorinated Polyethylene Sheeting for Concealed Water-Containment Membrane
ASTM E2129	(2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM F446	(1985; R 2009) Grab Bars and Accessories Installed in the Bathing Area

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (Bay Area AQMD)

Bay Area AQMD Rule 8-51	(1992; R 2001) Adhesive and Sealant Products

GREEN SEAL (GS)

GS-36	(2011) Commercial Adhesives

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	(2003) Dimension Stone Design Manual

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCNA Hdbk	(2013) Handbook for Ceramic, Glass, and Stone Tile Installation

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED GBDC	(2009) LEED Reference Guide for Green Building Design and Construction
LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

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

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

1.2 SUSTAINABILITY REQUIREMENTS

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 LEED DOCUMENTATION for project LEED NC [local/regional materials,] [low-emitting materials,] [recycled content,] [____] [and] [rapidly renewable materials] requirements.

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.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings[; G][; G, [_____]]

SD-03 Product Data

[Local/Regional Materials; (LEED NC)]
[Environmental Data]
Tile[; G][; G, [_____]]
Setting-Bed[; G][; G, [_____]]
Mortar, Grout, and Adhesive; (LEED)[; G][; G, [_____]]
Tile; (LEED NC)
Reinforcing Wire Fabric; (LEED NC)

SD-04 Samples

Tile[; G][; G, [_____]]
Accessories[; G][; G, [_____]]
Transition Strips[; G][; G, [_____]]
Grout[; G][; G, [_____]]

SD-07 Certificates

Tile
Mortar, Grout, and Adhesive

SD-08 Manufacturer's Instructions

Maintenance Instructions

SD-10 Operation and Maintenance Data

Installation[; G][; G, [_____]]

SD-11 Closeout Submittals

Local/Regional Materials; (LEED)
LEED Documentation
Tile; (LEED)
Adhesives; (LEED)

1.4 OTHER SUBMITTAL REQUIREMENTS

1.4.1 Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site and also the distance of raw material origin from the project site. For Tile and Reinforcing Wire Fabric indicate percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

1.4.2 Environmental Data

[Submit Table 1 of ASTM E2129 for the following products: [_____].]

1.5 QUALITY ASSURANCE

Installers to be from a company specializing in performing this type of work and have a minimum of two years experience. Each type and color of tile to be provided from a single source. Each type and color of mortar, adhesive, and grout to be provided from the same source.

1.6 DELIVERY, STORAGE, AND HANDLING

Ship tiles in sealed packages and clearly marked with the grade, type of tile, producer identification, and country of origin. Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.9 EXTRA MATERIALS

Supply an extra [2][_____] percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Furnish tiles that comply with ANSI A137.1 and are standard grade tiles[, the exception is glass tile. Furnish glass tiles that comply with ANSI A137.2]. Provide a minimum breaking strength of 125 lbs. for wall tile and 250 lbs. for floor tile in accordance with ASTM C648. Provide exterior building tile for cold climate projects that is approved by the manufacturer for exterior use when tested in accordance with ASTM C1026. Provide floor tiles with a wet dynamic coefficient of friction (DCOF) value of [0.42][_____] or greater when tested in accordance with ANSI A137.1 requirements. Provide glazed floor tile with a Class [III-Heavy Residential or Light Commercial][IV-Commercial][V-Heavy Commercial][_____] classification as rated by the manufacturer when tested in accordance with ASTM C1027 for visible abrasion resistance as related to foot traffic. [Indicate VOC content.] For materials like tile, accessories, and transition strips submit samples of sufficient size to show color range, pattern, type and joints. Submit manufacturer's catalog data.

2.1.1 Porcelain Tile

Furnish [[unglazed][or][glazed],][rectified] porcelain tile, [cove][bullnose] base and trim pieces[with color extending uniformly through the body of the tile]. [Provide tile with a [V0][V1][V2][V3][V4] aesthetic classification. Blend tiles in factory and in a packages to have same color range and continuous blend for installation.] Provide nominal tile size(s) of [6 by 6][12 by 12][18 by 18][12 by 24][_____] inch and [3/8][5/16][_____] inch thick. Provide a [0.50][_____] percent maximum water absorption in accordance with ASTM C373.

2.1.2 Mosaic Tile

Furnish [unglazed][glazed], mosaic tile[, [cove][bullnose] base] and trim composed of [natural clay][porcelain]. [Provide tile with a [V0][V1][V2][V3][V4] aesthetic classification. Blend tiles in factory and in a packages to have same color range and continuous blend for installation.] Provide [nominal tile size(s) of [1 by 1][1 by 2][2 by 2][_____] inch][a mixture of standard sizes in a stock pattern]. [Provide porcelain mosaics with a water absorption up to 0.50 percent][Provide natural clay mosaics with a water absorption up to [3.0][_____] percent] when tested in accordance with ASTM C373.

2.1.3 Quarry Tile

Furnish an unglazed quarry tile, [cove][bullnose] base and trim pieces. Provide tile with [smooth][abrasive] surface. Provide nominal tile size(s) of [6 by 6][_____] inch and 1/2 inch thick. Provide a [0.30][_____] percent maximum water absorption in accordance with ASTM C373.

2.1.4 Glass Tile

Furnish glass mosaic tile that complies with ANSI A137.2. Provide nominal tile size(s) of [1 by 1][_____] inch.

2.1.5 Glazed Wall Tile

Furnish glazed wall tile that has cushioned edges and trim with lead-free [bright][matte] finish. Provide nominal tile size(s) of [4-1/4 by

4-1/4][4-1/4 by 6][6 by 6] inch.

2.1.6 Accessories

Provide built-in type accessories of the same materials and finish as the wall tile. Provide accessories as follows:

	Quantity	Location
Recessed soap holders	[_____]	[_____]
Tumbler holders	[_____]	[_____]
Combination tumbler and toothbrush holders	[_____]	[_____]
Towel bars, [stainless steel][ceramic] [24] [30] inch long, two towel posts	[_____]	[_____]
Robe hooks	[_____]	[_____]
Roll paper holder	[_____]	[_____]
Recessed soap holder and hand hold combination: support static load in compliance with ASTM F446	[_____]	[_____]

2.2 SETTING-BED

Submit manufacturer's catalog data. Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C33/C33M for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C150/C150M for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C144 for sand.

2.2.4 Hydrated Lime

Conform to ASTM C206 for hydrated lime, Type S or ASTM C207, Type S.

2.2.5 Metal Lath

Conform to ASTM C847 for flat expanded type metal lath, and weighing a

minimum 2.5 pound/square yard.

2.2.6 Reinforcing Wire Fabric

Conform to ASTM A1064/A1064M for wire fabric. Provide [2 by 2 inch mesh, 16/16 wire] [or] [1-1/2 by 2 inch mesh, 16/13 wire].

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

Submit certificates indicating conformance with specified requirements. Submit LEED documentation relative to low-emitting materials credit in accordance with LEED GBDC. Include in LEED Documentation Notebook. [Interior adhesives, sealants, primers and sealants used as filler must meet the requirements of LEED low emitting materials credit.] Submit manufacturer's catalog data. Conform to [SCAQMD Rule 1168 and Bay Area AQMD Rule 8-51], and to the following for mortar, grout, adhesive, and sealant:

2.4.1 Dry-Set Portland Cement Mortar

TCNA Hdbk.

2.4.2 Latex-Portland Cement Mortar

TCNA Hdbk.

2.4.3 Ceramic Tile Grout

TCNA Hdbk; petroleum-free and plastic-free [sand portland cement grout] [dry-set grout] [latex-portland cement grout] [commercial portland cement grout].

2.4.4 Organic Adhesive

TCNA Hdbk, Type I. Water-resistant. Comply with applicable regulations regarding toxic and hazardous materials[, GS-36,] and as specified.

2.4.5 Epoxy Resin Grout

TCNA Hdbk. Prohibited unless specifically indicated otherwise.

2.4.6 Furan Resin Grout

TCNA Hdbk and consist of an intimate mixture of furfuryl-alcohol resin with carbon filler and catalyst. Prohibited unless specifically indicated otherwise.

2.4.7 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Grout sealant must not change the color or alter the appearance of the grout.

2.4.8 Cementitious Backer Board

Provide cementitious backer units, for use as tile substrate over wood sub-floors, in accordance with TCNA Hdbk. Furnish [1/4] [1/2]inch thick cementitious backer units.

2.4.9 Glass Mat Gypsum Backer Panel

Provide glass mat water-resistant gypsum backer board, for use as tile substrate over wood subfloors, in accordance with ASTM C1178/C1178M. Provide [1/4] [1/2] inch thick glass mat gypsum backer board.

2.5 TRANSITION STRIPS

Provide [[clear][_____] anodized aluminum transitions between tile and carpet or resilient flooring. Provide types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified][marble transitions appropriate for conditions. Categorize marble Group A as classified by MIA Design Manual. Provide a fine sand-rubbed finish marble, [[white][pink][gray][beige] in color][, color as specified in [Section 09 06 90 COLOR SCHEDULE][the drawings]]. Provide minimum 12.0 marble abrasion when tested in accordance with ASTM C241/C241M][solid surface transitions appropriate for conditions. Reference SECTION 06 61 16 SOLID POLYMER (SOLID SURFACING) FABRICATIONS for specifications]. Provide transition strips that comply with 36 CFR 1191requirements.

2.6 MEMBRANE MATERIALS

Conform to ASTM D226/D226M, Type 1 for 15 pound waterproofing membrane, asphalt-saturated building felt. Conform to [ASTM D2103] [ASTM D4068] 4 mil for polyethylene film.

2.7 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture in accordance with [Section 09 06 90 COLOR SCHEDULE][as indicated][[_____]. Color listed is not intended to limit the selection of equal colors from other manufacturers].[Provide floor patterns as specified on the drawings.]

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCNA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex Portland Cement Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Close space, in which tile is being set, to traffic and other work. Keep closed until tile is firmly set. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer. Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings showing ceramic tile pattern [elevations][and][floor plans]. Submit manufacturer's preprinted installation instructions.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCNA Hdbk, method [_____] and with grout joints [[as recommended by the manufacturer for the type of tile][of [_____] inch]. [Install thinner wall tile flush with thicker wall tile applied on same wall and provide installation materials as recommended by the tile and setting materials manufacturer's to achieve flush installation.]]

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 4 mil polyethylene membrane, metal lath, and scratch coat. Conform to TCNA Hdbk for workable mortar bed, materials, and installation of tile. Conform to TCNA Hdbk for cured mortar bed and materials.

3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Use [Dry-set] [or] [Latex-Portland Cement] to install tile in accordance with TCNA Hdbk. Use Latex Portland Cement when installing porcelain ceramic tile.

3.3.3 Organic Adhesive

Conform to TCNA Hdbk for the organic adhesive installation of ceramic tile.

3.3.4 Furan Mortar and Grout

Conform to TCNA Hdbk for furan mortar and grout installation.

3.3.5 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk. [Provide and apply manufacturer's standard [_____] product for sealing grout joints in accordance with manufacturer's recommendations.]

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCNA Hdbk method [_____] and with grout joints [as recommended by the manufacturer for the type of tile][of [_____] inch]. Install shower receptors in accordance with TCNA Hdbk method [B414] [B415].

3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCNA Hdbk for workable mortar bed materials and installation. Conform to TCNA Hdbk for cured mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

3.4.2 Dry-Set and Latex-Portland Cement

Use [dry-set] [or] [Latex-Portland cement] mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCNA Hdbk. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Resinous Grout

When resinous grout is indicated, grout quarry tile with either furan or epoxy resin grout. Rake and clean joints to the full depth of the tile and neutralize when recommended by the resin manufacturer. Install epoxy resin grout in conformance with TCNA Hdbk. Install resin grout in accordance with manufacturer's printed installation instructions. Provide a coating of wax applied from the manufacturer on all tile installed and furan resin. Follow manufacturer's printed installation instructions of installed resin grout for proportioning, mixing, installing, and curing. Maintain the recommended temperature in the area and on the surface to be grouted. Protect finished grout of grout stain.

3.4.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk. Provide and apply manufacturer's standard [_____] product for sealing grout joints in accordance with manufacturer's recommendations.

3.4.5 Waterproofing

Shower pans are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Conform to the requirements of Section 07 12 00 BUILT-UP BITUMINOUS WATERPROOFING for waterproofing under concrete fill.

3.4.6 Concrete Fill

Provide a 3500 psi concrete fill mix to dry as consistency as practicable. [Compose concrete fill by volume of 1 part Portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mix with water to as dry a consistency as practicable.] Spread, tamp, and screed concrete fill to a

true plane, and pitch to drains or levels as shown. Thoroughly damp concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 2 inch. Tie laps together with 18 gauge wire every 10 inch along the finished edges and every 6 inch along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance between the under-floor surface and the finished tiles floor surface is a minimum of 2 inches, and of the same thickness that the mortar setting-bed over the concrete fill with the thickness required in the specified TCNA Hdbk method.

3.5 INSTALLATION OF TRANSITION STRIPS

Install transition strips where indicated, in a manner similar to that of the ceramic tile floor and as recommended by the manufacturer. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

3.6 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.6.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

3.7 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles. Submit copy of manufacturer's printed maintenance instructions.

-- End of Section --

SECTION 09 51 00

ACOUSTICAL CEILINGS
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 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 A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A489	(2012) Standard Specification for Carbon Steel Lifting Eyes
ASTM A580/A580M	(2013b) Standard Specification for Stainless Steel Wire
ASTM A641/A641M	(2009a) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B633	(2013) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C635/C635M	(2013a) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C834	(2014) Latex Sealants

ASTM E119	(2012a) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E1264	(2008; E 2010) Acoustical Ceiling Products
ASTM E1414/E1414M	(2011a) Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E1477	(1998a; R 2013) Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
ASTM E580/E580M	(2014) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E795	(2005; R 2012) Mounting Test Specimens During Sound Absorption Tests
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2013) Seismic Design for Buildings

UL ENVIRONMENT (ULE)

ULE Greenguard	UL Greenguard Certification Program

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	(2012) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. The unit size, texture, finish, and color must be as specified. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Submit drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan. Coordinate with paragraph RECLAMATION PROCEDURES for reclamation of mineral fiber acoustical ceiling panels to be removed from the job site.

1.2.1 Fire Resistive Ceilings

Rate acoustical ceiling systems, indicated as fire resistant, for fire endurance as specified when tested in accordance with ASTM E119. Test suspended ceiling with a specimen [roof] [floor] assembly representative of

the indicated construction, including mechanical and electrical work within ceiling space openings for light fixtures, and air outlets, and access panels. Provide ceiling assembly rating for [[1] [1-1/2] [2] [3] [4] hour [concealed grid system] [exposed grid system]] [as shown on drawings]. Provide acoustical units with a flame spread of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E84.

1.2.2 Ceiling Attenuation Class and Test

Provide a ceiling system with an attenuation class (CAC) of [_____] for [_____] [and _____ for _____] when determined in accordance with ASTM E1414/E1414M. Provide fixture attenuators over light fixtures and other ceiling penetrations, and provide acoustical blanket insulation adjacent to partitions, as required to achieve the specified CAC. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

1.2.3 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423 Test Method.

1.2.4 Light Reflectance

Determine light reflectance factor in accordance with ASTM E1477 Test Method.

1.2.5 Other Submittals Requirements

The following shall be submitted:

a. Manufacturer's data indicating percentage of recycle material in acoustic ceiling tiles to verify affirmative procurement compliance.

b. Total weight and volume quantities of acoustic ceiling tiles with recycle material.

c. Manufacturer's catalog showing UL classification of fire-rated ceilings giving materials, construction details, types of floor and roof constructions to be protected, and UL design number and fire protection time rating for each required floor or roof construction and acoustic ceiling assembly.

d. Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified [fire endurance] [and] [sound transmission] requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resistance may be submitted in lieu of test reports.

e. Certificate attesting that the mineral based acoustical units furnished for the project contain recycled material and showing an estimated percent of such material.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G"

designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

SD-03 Product Data

Acoustical Ceiling Systems
Certification

SD-04 Samples

Acoustical Units
Acoustic Ceiling Tiles

SD-06 Test Reports

Fire Resistive Ceilings
Ceiling Attenuation Class and Test

SD-07 Certificates

Acoustical Units
Acoustic Ceiling Tiles

1.4 SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified in accordance with ULE Greenguard[Gold], SCS Scientific Certification Systems Indoor Advantage[Gold]or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.6 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.7 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.9 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of [_____] [5] tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS. Submit two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E1264, Class A, and the following requirements:

2.1.1 Affirmative Procurement

Mineral Wool, Cellulose, and Laminated Paperboard used in acoustic ceiling tiles are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/). EPA's recommended Recovered Materials Content Levels for Mineral Wool, Cellulose, Structural Fiberboard and Laminated Paperboard are:

Product	Material	Percent of Post Consumer Materials	Percent of Total Recovered Materials
Laminate Paperboard	Post Consumer Paper	100	100
Rock Wool	Slag	75	
Cellulose	Post Consumer Paper	75	75

a. The recommended recovered materials content levels are based on the weight (not volume) of materials in the insulating core only.

b. Submit recycled material content data for acoustic ceiling tiles indicating compliance with affirmative procurement.

c. Submit total weight and volume quantities of acoustic ceiling tiles with recycle material.

2.1.2 Units for Exposed-Grid System [A] [_____]

2.1.2.1 Type

[I (cellulose composition)] [III (non-asbestos mineral fiber with painted finish)] [IV (non-asbestos mineral fiber with membrane-faced overlay)] [IX (mineral fiber with scrubbable finish)] [X (mineral composition with plastic membrane)] [XI (mineral fiber with fabric faced overlay)] [XII

(fiberglass base with membrane-faced overlay)]

2.1.2.2 Flame Spread

Class A, 25 or less

2.1.2.3 Pattern

[A] [B] [C] [D] [E] [F] [G] [I] [J] [K] [_____]

2.1.2.4 Minimum NRC

[0.75] [_____] in open office areas; [0.60] [_____] in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; [0.50] [_____] in all other rooms and areas when tested on mounting Type E-400 of ASTM E795.

2.1.2.5 Minimum Light Reflectance Coefficient
[LR-1, 0.75 or greater] [_____]

2.1.2.6 Nominal Size

[24 by 48] [_____] inch

2.1.2.7 Edge Detail

[Square] [Reveal] [Trimmed and butt] [_____]

2.1.2.8 Finish

Factory-applied [standard finish] [color finish].

2.1.2.9 Minimum CAC

[40] [_____]

2.1.3 Units for Concealed-Grid System [A] [_____]

2.1.3.1 Type

[I (cellulose composition)] [III (non-asbestos mineral fiber with painted finish)] [IV (non-asbestos mineral fiber with membrane-faced overlay)] [IX (mineral fiber with scrubbable finish)] [X (mineral composition with plastic membrane)] [XI (mineral fiber with fabric faced overlay)] [XII (fiberglass base with membrane-faced overlay)]

2.1.3.2 Flame Spread

Class A, 25 or less

2.1.3.3 Pattern

[A] [B] [C] [D] [E] [F] [G] [I] [J] [K] [_____]

2.1.3.4 Minimum NRC

[0.50] [_____] when tested on mounting Type B or Type E-400 of ASTM E795

2.1.3.5 Minimum Light Reflectance Coefficient

[LR-1, 0.75 or greater] [_____]

2.1.3.6 Nominal Size

[12 by 12] [_____] inch

2.1.3.7 Edge Detail

[Beveled] [Square]

2.1.3.8 Joint Detail

[kerfed and rabbeted] [tongue and grooved]

2.1.3.9 Finish

Factory-applied [standard finish] [color finish]

2.1.3.10 Minimum CAC

[40] [_____]

2.1.4 Metal Pans [A] [_____]

2.1.4.1 Type

[V, steel] [VI, ASTM A167 stainless steel] [VII, aluminum] perforated pans with acoustical, non-asbestos, insulation backing

2.1.4.2 Flame Spread

Class: A, 25 or less

2.1.4.3 Pattern

[A] [C] [I] [_____]

2.1.4.4 Minimum NRC

[0.75] [_____] in open office areas; [0.60] [_____] in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; [0.50] [_____] in all other rooms and areas when tested on mounting Type E-400 of ASTM E795.

2.1.4.5 Minimum Light Reflectance Coefficient

[LR-1, 0.75 or greater] [_____]

2.1.4.6 Nominal Size

[24 by 24] [_____] inch

2.1.4.7 Edge Detail

Manufacturer's standard.

2.1.4.8 Joint Detail

[Beveled] [_____]

2.1.4.9 Finish

Factory-applied standard finish

2.1.4.10 Pads

[Completely enclosed, of material and thickness required for acoustical and fire test ratings] [_____].

2.1.5 Impact/Abrasion Resistant Units

2.1.5.1 Type

Non-asbestos mineral composition with a hardened mineral surface and factory applied white paint finish. Provide a surface resistant to impact and abrasion.

2.1.5.2 Flame Spread

Class A, 25 or less

2.1.5.3 Pattern

[_____]

2.1.5.4 Minimum NRC

[0.50] [_____] when tested on Mounting Type E-400 of ASTM E795.

2.1.5.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.1.5.6 Nominal Size

[12 by 12] [24 by 24] [24 by 48] [_____] inch

2.1.5.7 Edge Detail

[Square] [Beveled]

2.1.5.8 Joint Detail

[Trimmed and butted] [Kerfed and rabbeted]

2.1.6 Humidity Resistant Composition Units

2.1.6.1 Type

Non-asbestos mineral or glass fibers bonded with ceramic, moisture resistant thermo-setting resin, or other moisture resistant material and having a factory applied white paint finish. Provide panels that do not sag or warp under conditions of heat, high humidity or chemical fumes.

2.1.6.2 Flame Spread

Class: A, 25 or less

2.1.6.3 Pattern

[_____]

2.1.6.4 Minimum NRC

Minimum [0.50] [_____] when tested on Mounting Type E-400 of ASTM E795.

2.1.6.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.1.6.6 Nominal Size

[24 by 48] [_____] inch

2.1.6.7 Edge Detail

Square

2.1.7 Metal Faced Composition Units

2.1.7.1 Type

[Type V (Steel facings with non-asbestos mineral composition absorbent backing).] [Type VI (Stainless steel facings with non-asbestos mineral composition absorbent backing)] [Type VII (Aluminum facings with non-asbestos mineral composition absorbent backing) with [anodized] [baked enamel] [acrylic] finish color [white] [_____].]

2.1.7.2 Flame Spread

Class: A, flame spread 25 or less

2.1.7.3 Pattern

[_____]

2.1.7.4 Minimum (NRC)

[0.75] [____] in open office areas. [0.60] [____] in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated. [0.50] [____] in all other rooms and areas. Base the tested NRC value on Mounting Type E-400 of ASTM E795.

2.1.7.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.1.7.6 Nominal Size

24 by [24] [48] inch

2.1.7.7 Edge Detail

Square

2.1.7.8 Joint Detail

Trimmed and butted

2.1.8 Unit Acoustical Absorbers

Absorbers shall be individually mounted sound absorbing plaques composed of glass fibers or non-asbestos mineral fibers and having a NRC range of not less than 0.60 - 0.70 when tested in accordance with ASTM C423 and reported as a 4 frequency average.

2.2 SUSPENSION SYSTEM

Provide [[standard] [fire-resistive] [snap-in metal pan]] [[exposed-grid] [indirect hung concealed H and T or Zee] [direct hung, concealed, downward access] [direct hung, concealed, upward access]] [[standard width flange] [narrow width flange] [narrow width slotted flange]] [as shown on drawings] suspension system conforming to ASTM C635/C635M [for intermediate-duty systems] [for heavy-duty systems]. Provide surfaces exposed to view of [aluminum or steel with a factory-applied [white] [black] [color] baked-enamel finish] [aluminum with a clear anodized finish] [aluminum with colored factory-applied vinyl paint finish]. Provide wall molding having a flange of not less than [15/16 inch] [_____]. Provide [inside and outside corner caps] [[standard] [overlapped] [mitered] corners]. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the [guidance in UFC 3-310-04 and ASTM E580/E580M] [contract drawings].

2.3 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Conform wires to [ASTM A641/A641M, Class 1, [0.08 inch (12 gauge)] [[_____] inch] in diameter.] [ASTM A580/A580M, composition 302 or 304, condition annealed stainless steel, [0.08 inch (12 gauge)] [[_____] inch] in diameter.]

2.3.2 Straps

Provide straps of 1 by 3/16 inch galvanized steel conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

2.3.3 Rods

Provide 3/16 inch diameter threaded steel rods, zinc or cadmium coated.

2.3.4 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in

accordance with ASTM A489. Eyebolt size must be a minimum [_____] [1/4] inch, [zinc coated][cadmium plated].

2.3.5 Masonry Anchorage Devices

Comply with [ASTM C636/C636M] [_____] for anchorage devices for [eyebolts] [machine screws] [wood screws].

2.4 ACCESS PANELS

Provide access panels that match adjacent acoustical units, designed and equipped with suitable framing and fastenings for removal and replacement without damage. Size panel to be not less than 12 by 12 inch or more than 12 by 24 inch.

a. Attach an identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, near one corner on the face of each access panel.

b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. Provide plates or buttons of minimum 1 inch diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the Contracting Officer. Code identification system is as follows:

1 Fire detection/alarm system

2 Air conditioning controls

3 Plumbing system

4 Heating and steam systems

5 Air conditioning duct system

6 Sprinkler system

7 Intercommunication system

8 Nurse's call system

9 Pneumatic tube system

10 Medical piping system

11 Program entertainment

12 Telephone junction boxes

13 Detector X-ray

14 [_____]

2.5 ADHESIVE

Use adhesive as recommended by tile manufacturer.

2.6 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.7 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components [as specified in Section 09 06 90 COLOR SCHEDULE] [_____].

2.8 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C636/C636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.1.5 Adhesive Application

Wipe back of tile to remove accumulated dust. Daub acoustical units on back side with four equal daubs of adhesive. Apply daubs near corners of tiles. Ensure that contact area of each daub is at least 2 inch diameter in final position. Press units into place, aligning joints and abutting units tight and uniform without differences in joint widths.

3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

3.4 RECLAMATION PROCEDURES

Neatly stack ceiling tile, designated for recycling by the Contracting Officer, on 4 by 4 foot pallets not higher than 4 foot. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

-- End of Section --

SECTION 09 65 00

RESILIENT FLOORING
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 D4078	(2002; R 2008) Water Emulsion Floor Polish
ASTM D5603	(2001; R 2008) Rubber Compounding Materials - Recycled Vulcanizate Particulate Rubber
ASTM E2129	(2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E648	(2014c) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F1066	(2004; E 2010; R 2010) Standard Specification for Vinyl Composition Floor Tile
ASTM F1303	(2004; R 2014) Sheet Vinyl Floor Covering with Backing
ASTM F1344	(2012; E 2013) Rubber Floor Tile
ASTM F1482	(2004; E 2009; R 2009) Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F1700	(2013a) Solid Vinyl Floor Tile
ASTM F1859	(2012) Rubber Sheet Floor Covering Without Backing
ASTM F1860	(2012) Rubber Sheet Floor Covering With Backing
ASTM F1861	(2008; E 2012; R 2012) Resilient Wall Base
ASTM F1869	(2011) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F1913	(2004; R 2010) Vinyl Sheet Floor Covering

	Without Backing
ASTM F2034	(2008; R 2013) Sheet Linoleum Floor Covering
ASTM F2169	(2012) Resilient Stair Treads
ASTM F2170	(2011) Determining Relative Humidity in Concrete Floor Slabs in situ Probes
ASTM F2195	(2013) Linoleum Floor Tile
ASTM F710	(2011) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

GREEN SEAL (GS)

GS-36	(2011) Commercial Adhesives

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 3813	(2004) Resilient Floor Coverings - Cork Floor Tiles

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 253	(2011) Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

1.2 SYSTEM DESCRIPTION

1.2.1 Environmental Data

[Submit Table 1 of ASTM E2129 for the following products: [_____].]

1.2.2 Fire Resistance Requirements

Provide a critical radiant flux of not less than [0.45 watts per square centimeter (Class 1)] [0.22 watts per square centimeter (Class 2)] for flooring in corridors and exits when tested in accordance with ASTM E648 or NFPA 253.

1.2.3 Other Submittal Requirements

The following shall be submitted in accordance with LEED NC:

a. documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

b. documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

c. documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

1.3 SUSTAINABILITY REQUIREMENTS

Materials in this technical specification may contribute towards contract compliance with sustainability requirements.

1.3.1 LEED REQUIREMENTS

See Section 01 33 29 LEED DOCUMENTATION for project LEED NC [local/regional materials,] [low-emitting materials,] [recycled content,] [____] [and][rapidly renewable materials] requirements.

1.3.2 USDA Biobased

See Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS for requirements associated with USDA Biobased designated products.

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.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Resilient Flooring and Accessories[; G][; G, [_____]]

SD-03 Product Data

Resilient Flooring and Accessories[; G][; G, [_____]]
Adhesives; (LEED NC)
Vinyl Composition Tile
Sheet Vinyl Flooring
Rubber Tile
Rubber Sheet Flooring
Solid Vinyl Tile
Cement-Fiber Board
Wall Base
Stair Treads, Risers and Stringers
[Local/Regional Materials]
[Environmental Data]

[Sheet Linoleum]
Linoleum Tile
Cork

SD-04 Samples

Resilient Flooring and Accessories[; G][; G, [_____]]

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests[; G][; G, [_____]]

SD-08 Manufacturer's Instructions

Surface Preparation[; G][; G, [_____]]
Installation[; G][; G, [_____]]

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories[; G][; G, [_____]]

SD-11 Closeout Submittals

LEED Documentation

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions, including [_____]. Do not store exposed rubber surface materials in occupied spaces. [Do not store [_____] near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.]

1.6 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.7 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

1.9 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of [[_____] [5] tiles for each 1000 tiles] [and] [[_____] [5] square feet for each 1000 square feet of sheet flooring] installed. Provide extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE [TYPE [A][_____]]

Conform to ASTM F1066 [Class 1, (solid color tile),] [Class 2, (through pattern tile),] Composition 1, asbestos-free, [12] [_____] inch square and [3/32] [1/8] inch thick. Provide color and pattern uniformly distributed throughout the thickness of the tile. Tile shall contain a minimum of [90] [100] [_____] percent recycled material.

2.2 SHEET VINYL FLOORING [TYPE [A][_____]]

Conform to [ASTM F1303, Type I, Grade 1, [Class A-non-asbestos formulated fibrous backing] [or] [Class B-nonfoamed plastic backing] (minimum wear layer thickness 0.020 inch and minimum overall thickness 0.080 inch) and a minimum [6 feet] [12 feet] wide.] [ASTM F1303, Type II, Grade 1, without backing (minimum wear layer thickness 0.080 inch and minimum overall thickness 0.080 inch), and a minimum 6 feet wide. Extend color and pattern through the total thickness of the material.] [ASTM F1303, Type II, Grade 1, [Class A non-asbestos formulated fibrous backing] [or] [Class B nonfoamed plastic backing] (minimum wear layer thickness 0.050 inch and minimum overall thickness 0.080 inch) and a minimum 6 feet wide. Extend color and pattern throughout the thickness of the wear layer.] [ASTM F1913, (minimum wear layer thickness 0.075 inch and minimum overall thickness 0.075 inch) and a minimum 6 feet wide. Extend color and pattern through the total thickness of the material.] As required, provide welding rods as recommended by the manufacturer for heat welding of joints.

2.3 RUBBER TILE [TYPE [A][_____]]

Conform to ASTM F1344 [Class 1 homogeneous] [Class 2 layered], [Type A (solid color)] [Type B (through mottled)], [12] [18] [24] [36] [_____] inch square. Provide [smooth] [_____] [raised [round] [square] [diamond] surface studs with chamfered edges. Provide [high] [low]] stud profile. Provide [0.125] [_____] inch overall thickness. [With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D5603, fine mesh size particulate, [Grade 1, 2, or 3] [Grade 4] [Grade 5] [Grade 6]].

2.4 RUBBER SHEET FLOORING [TYPE [A] [_____]]

Conform to [ASTM F1859 (flooring without backing), [Type I homogeneous]

[Type II layered]] [or] [ASTM F1860 (flooring with backing), [Type I homogeneous] [Type II layered]], [minimum] [36 inch] [_____] wide. Provide [smooth] [embossed] [_____] surface. Provide [0.080] [0.100] [0.118] [_____] inch overall thickness.[With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D5603, fine mesh size particulate, [Grade 1, 2, or 3] [Grade 4] [Grade 5] [Grade 6].]

2.5 SOLID VINYL TILE [TYPE [A][_____]]

Conform to ASTM F1700 [Class I monolithic (minimum wear layer thickness 0.125 inch and minimum overall thickness 0.125 inch] [Class III printed film minimum wear layer thickness 0.020 inch and minimum overall thickness 0.125 inch], Type [A (smooth)] [B (embossed)]. Provide [12] [16] [18] [24] [36] [_____] inch square tile.

2.6 SHEET LINOLEUM [TYPE [A][_____]]

Conform to ASTM F2034 and consist of a homogeneous layer of a mixture of linoleum cement (binder in linoleum consisting of a mixture of linseed oil, pine rosin, fossil, or other resins or rosins, or an equivalent oxidized oleoresinous binder), cork and/or wood flour, mineral fillers, and pigments bonded to a jute backing. Provide a minimum 6 feet wide and overall thickness not less than [0.080 inch] [0.100 inch] [0.125 inch] for linoleum. As required, provide welding rods as recommended by the manufacturer for heat welding of joints.

2.7 LINOLEUM TILE [TYPE [A][_____]]

Conform to ASTM F2195 and consist of a homogeneous layer of a mixture of linoleum cement (binder in linoleum consisting of a mixture of linseed oil, pine rosin, fossil, or other resins or rosins, or an equivalent oxidized oleoresinous binder), cork and/or wood flour, mineral fillers, and pigments bonded to a [polyester] [_____] backing. Provide square tiles a minimum [18 inch] [_____] square and overall thickness [0.08 inch] [_____] minimum for linoleum tile.

2.8 CORK

Conform to ISO 3813, and be [12] [_____] inches square and [3/16][_____] inches to [5/16] [_____] inches thick. [Provide cork-faced MDF tongue-and-groove planks with cork facing.] Do not use products made with urea-formaldehyde binder.

2.9 WALL BASE

Conform to ASTM F1861, [[Type TS (vulcanized thermoset rubber)] [or] [Type TP (thermoplastic rubber)]] [, or] [Type TV (thermoplastic vinyl)], [Style A (straight - installed with carpet)] [,] [and] [Style B (coved - installed with resilient flooring)] [,] [and] [Style C (butt toe cove installed with 1/8 inch thick flooring)]. Provide [4] [6] inch high and a minimum 1/8 inch thick wall base. Provide [preformed] [job formed] corners in matching height, shape, and color. [With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D5603, fine mesh size particulate, [Grade 1, 2, or 3] [Grade 4] [Grade 5] [Grade 6].]

2.10 INTEGRAL COVE BASE

Extend integral coved base for [[sheet vinyl] [and] [sheet linoleum] flooring up the wall [4] [6] inch]. Provide a [vinyl] [or] [rubber] [clear

anodized aluminum], [square] [round] cap strip and vinyl, rubber, or wood fillet strip with a minimum radius of 3/4 inch for integral coved bases [at perimeter and fixed vertical interruptions to flooring] [as shown]. Provide integral cove of the same material as flooring. [Provide inside and outside corner protectors of [[_____]-colored anodized aluminum] [clear anodized aluminum] [or] [plastic] approved by flooring manufacturer.]

2.11 STAIR TREADS, RISERS AND STRINGERS

Conform to ASTM F2169, [[Type TS (vulcanized thermoset rubber)] [or] [Type TP (thermoplastic rubber)]] [or] [Type TV (thermoplastic vinyl)]. Conform to ASTM F2169 for surface of treads [Class 1 smooth] [[Class 2 raised [round] [square] [diamond] stud] [ribbed] pattern] [and have [Group 1 abrasive non-slip strip] [Group 2 strip for visually impaired of contrasting [_____] color of [same] [abrasive] material]]. Provide [square] [or] [round] nosing. Provide either a one piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser.[With Vulcanizate Particulate Rubber, use recycled tire treads in accordance with ASTM D5603, fine mesh size particulate, [Grade 1, 2, or 3] [Grade 4] [Grade 5] [Grade 6].]

2.12 MOULDING

Provide tapered mouldings of [[vinyl] [or] [rubber]] [[_____]-colored anodized aluminum] [clear anodized aluminum] and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.13 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. [VOC content shall be less than [50 grams/L] [the current VOC content limits of [GS-36][and][SCAQMD Rule 1168]].] Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

2.14 SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions. Comply with ASTM F1482 for panel type underlayment products. Use one of the following substrates:

[a. Particleboard: As specified in Section 06 10 00 ROUGH CARPENTRY.]

[b. Fiberboard: As specified in Section 06 10 00 ROUGH CARPENTRY.]

[c. Cork: As specified in Section 06 10 00 ROUGH CARPENTRY]

[d. Cement-fiber board: Portland cement, sand, recycled cellulose[with a minimum of [5] [10] [_____] percent post-consumer recycled content, or [20] [40] [_____] percent post-industrial recycled content].]

[e. Plywood: As specified in Section 06 10 00 ROUGH CARPENTRY.]

[f. Concrete.]

2.15 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D4078 for polish.

2.16 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.17 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories [in accordance with Section 09 06 90 COLOR SCHEDULE] [as indicated on the drawings] [selected from manufacturer's standard colors] [[_____]. Color listed is not intended to limit the selection of equal colors from other manufacturers].[Provide floor patterns as specified on the [drawings Sheet No. [_____]] [_____].] Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions. Submit manufacturer's descriptive data and [three] [_____] samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 2-1/2 by 4 inch. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. Comply with ASTM F1482 for panel type underlayments. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove concrete curing and sealer compounds from the slabs, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F1869 or ASTM F2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

3.4 PLACING VINYL COMPOSITION, LINOLEUM AND SOLID VINYL TILES

Install tile flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.5 PLACING SHEET VINYL FLOORING

Install sheet vinyl flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.[Provide [chemically bonded] [or] [heat welded] seams and edges [in rooms [_____]] [shown on the drawings] in accordance with the manufacturer's written installation instructions. Finish joints flush, free from voids, recesses, and raised areas.] [Install flooring with an integral coved base.]

3.6 PLACING SHEET LINOLEUM FLOORING

Install sheet linoleum flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied. Cut seams by overlapping or underscribing as recommended by the manufacturer. [Provide heat welded seams [in rooms [_____]] [as shown on the drawings] in accordance with there manufacturer's written installation instructions.] Finish joints flush, free from voids, recesses, and raised areas. [Install flooring with an integral coved base.]

3.7 PLACING RUBBER TILE

Install rubber tile and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles, except where irregular-shaped rooms makes it impossible. Cut flooring to fit around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.

3.8 PLACING RUBBER SHEET FLOORING

Install rubber sheet flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut seams by overlapping or underscribing as recommended by the manufacturer. Lay out sheets to minimize waste. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.

3.9 PLACING CORK

Cork [tile] [plank flooring] and accessories shall be installed in accordance with manufacturer's installation instructions. Adhesives shall be prepared and applied in accordance with manufacturer's directions. Flooring lines and joints shall be square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. [Vary width of edge tiles as necessary to maintain full-size tiles in field, but no edge tile shall be less than one-half full size, except where irregular-shaped rooms makes it impossible.] Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Flooring shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.10 PLACING FEATURE STRIPS

Install feature strips in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.11 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. [Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions.] [Anchor aluminum moulding to floor surfaces as recommended by the manufacturer.]

3.12 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation

instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.13 PLACING STAIR TREADS, RISERS, AND STRINGERS

Secure and install stair treads, risers, and stringers in accordance with manufacturer's printed installation instructions. Cover the surface of treads and risers[the full width of the stairs][within 6 inch to the stair edges]. Provide equal length pieces butted together to cover the treads and risers for stairs wider than manufacturer's standard lengths. [Provide stringer angles on both the wall and banister sides of the stairs, and landing trim.]

3.14 PLACING INTEGRAL COVED BASE

Install integral cove base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Shape integral coved base by extending the flooring material [4] [6] [_____] inch onto the wall surface. Support cove by a filler. Provide a cap strip at the top of the base. Fill voids along the top edge of base at masonry walls with caulk.

3.15 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry/clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and/or finish in accordance with manufacturer's written instructions.

3.16 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

SECTION 09 68 00

CARPETING
11/13

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 107	(2013) Colorfastness to Water
AATCC 134	(2011; E 2013) Electrostatic Propensity of Carpets
AATCC 16	(2004; E 2008; E 2010) Colorfastness to Light
AATCC 165	(2013) Colorfastness to Crocking: Textile Floor Coverings - Crockmeter Method
AATCC 174	(2011) Antimicrobial Activity Assessment of Carpets

ASTM INTERNATIONAL (ASTM)

ASTM D1335	(2012) Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
ASTM D1667	(2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D297	(2013) Rubber Products - Chemical Analysis
ASTM D3278	(1996; R 2011) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D3574	(2011) Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams
ASTM D3676	(2013) Rubber Cellular Cushion Used for Carpet or Rug Underlay
ASTM D5793	(2013) Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings
ASTM D5848	(2010; E 2010) Mass Per Unit Area of Pile Yarn Floor Coverings
ASTM D6859	(2011) Standard Test Method for Pile Thickness of Finished Level Pile Yarn

Floor Coverings

ASTM E2129 (2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products

ASTM E648 (2014c) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI CIS (2011) Carpet Installation Standard

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551 (1981) Machine-made Textile Floor Coverings - Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC (2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

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

16 CFR 1630 Standard for the Surface Flammability of Carpets and Rugs (FF 1-70)

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

WOOLMARK COMPANY (WBI)

Woolmark (1964) Certification for Use of 100 Percent Wool

1.2 SYSTEM DESCRIPTION

1.2.1 Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

1.2.2 Environmental Data

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project. [Submit Table 1 of ASTM E2129 for the following products: [_____].]Submit documentation indicating relative dollar value of rapidly renewable materials to total dollar value of products included in project.

1.2.3 Scheduling

Install carpet systems after the installation and ventilation period of materials or finishes which have high short-term emissions of VOCs, formaldehyde, particulates, or other air-borne compounds which may be adsorbed by or settle on the carpet tiles, including [_____].

1.3 SUSTAINABILITY REQUIREMENTS

Materials in this technical specification may contribute towards contract compliance with sustainability requirements.

1.3.1 LEED REQUIREMENTS

See Section 01 33 29 LEED DOCUMENTATION for project LEED NC [local/regional materials,] [low-emitting materials,] [recycled content,] [____] [and] [rapidly renewable materials] requirements.

1.3.2 EPA Comprehensive Procurement Guidelines

See Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS for requirements associated with EPA designated products.

1.3.3 USDA Biobased

See Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS for requirements associated with USDA Biobased designated products.

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.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings[; G][; G, [_____]]
Moldings[; G][; G, [_____]]

SD-03 Product Data

Carpet[; G][; G, [_____]]
Carpet Cushion[; G][; G, [_____]]
Moldings[; G][; G, [_____]]
Physical Characteristics; (LEED NC)
Local/Regional Materials; (LEED NC)
Environmental Data

SD-04 Samples

Carpet[; G][; G, [_____]]
Moldings[; G][; G, [_____]]
Carpet Cushion[; G][; G, [_____]]

SD-06 Test Reports

Moisture and Alkalinity Tests[; G][; G, [_____]]

SD-07 Certificates

Carpet
Regulatory Requirements

SD-08 Manufacturer's Instructions

Surface Preparation
Installation

SD-10 Operation and Maintenance Data

Carpet[; G][; G, [_____]]
Cleaning and Protection[; G][; G, [_____]]
Maintenance Service

SD-11 Closeout Submittals

LEED Documentation
Local/Regional Materials; (LEED NC)

1.5 QUALITY ASSURANCE

Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label for carpet, carpet cushion, and adhesives or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet, carpet cushion, and adhesives bearing the label will indicate that the carpet has been tested and meets the Regulatory Requirements and criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Procure carpet in accordance with 40 CFR 247, and where possible, purchased locally to reduce emissions of fossil fuels from transporting. Conform to EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS for carpet. Submit certificates, showing conformance with the referenced standards contained in this section, for the following: Carpet, Carpet Cushion and Molding. Include in the report percentage of post-industrial and post-consumer recycled material and relative dollar value of recycled content products to total dollar value of products included in project.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues, and maintain at a temperature above 60 degrees F for 2 days prior to installation. Do not store carpet or carpet tiles with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants, including [_____]. Do not store carpet near materials that may off gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.7 AMBIENT CONDITIONS

Maintain areas in which carpeting is to be installed at a temperature above 60 degrees F and below 90 degrees F for 2 days before installation, during installation, and for 2 days after installation. Provide temporary ventilation during work of this section. Maintain a minimum temperature of 55 degrees F thereafter for the duration of the contract.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties including minimum ten year wear warranty, two year material and workmanship and ten year tuft bind and delamination.

PART 2 PRODUCTS

2.1 CARPET

Furnish first quality carpet; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Provide carpet materials and treatments as reasonably nonallergenic and free of other recognized health hazards. Provide a static control construction on all grade carpets which gives adequate durability and performance. Submit manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory. Submit manufacturer's catalog data for 1) Carpet, 2) Carpet Cushion, and 3) Moldings. Also, submit samples of the following:

a. Carpet: [Two] [_____] "Production Quality" samples 18 by 18 inches of each carpet proposed for use, showing quality, pattern, and color specified

b. Moldings: [Two] [_____] pieces of each type at least 12 inches long

c. Special Treatment Materials: [Two] [_____] samples showing system and installation method

2.1.1 Physical Characteristics for [Broadloom][Modular Tile][Entrance] Carpet

2.1.1.1 Carpet Construction

[Tufted] [Woven] [Bonded] [Needlebond] [Needle Felt] [_____]

2.1.1.2 Type

[Broadloom [12] [6] feet minimum usable carpet width [with exception of corridors] [and] [stairs] [_____].][Modular tile [18 by 18] [20 by 20] [24 by 24] inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551.] [Entrance [18 by 18] [_____] inch square [12] [6] feet width [_____] mat size.]

2.1.1.3 Pile Type

[Level-loop] [Multilevel loop] [Cut and loop] [Frieze] [Cut pile] [Random sheared] [Level tip shear]

2.1.1.4 Pile Fiber

Commercial 100 percent branded (federally registered trademark) [nylon continuous filament] [nylon staple] [triexta or PTT] [wool with Woolmark certification] [wool blend with Wool Bureau certification] [_____].

2.1.1.5 Gauge or Pitch

Minimum [_____] inch in accordance with ASTM D5793

2.1.1.6 Stitches or Rows/Wires

Minimum [_____] per square inch

2.1.1.7 Surface Pile Weight

Minimum [_____] ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D5848.

2.1.1.8 Pile Thickness

Minimum [_____] inch in accordance with ASTM D6859

2.1.1.9 Pile Density

Minimum [_____]

2.1.1.10 Dye Method

[Solution dyed] [Stock dyed] [Yarn (or Skein) dyed] [Piece dyed] [Space dye] [Continuous dye]

2.1.1.11 Backing Materials

Provide primary backing materials like [those customarily used and accepted by the trade for each type of carpet] [polypropylene] [synthetic material] [synthetic material] [rubber] [jute] [cotton] [_____]. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

2.1.1.12 Attached Cushion

Provide an attached cushion [chemically frothed polyurethane with minimum weight of 18 oz/sq. yard, minimum density of 11 lb/cubic foot] [mechanically frothed polyurethane with minimum weight of 22 oz/sq. yard, minimum density of 14 lb/cubic foot, minimum thickness of 0.100 inch, and maximum compression resistance of 5 psi, and compression set of 15 percent in accordance with ASTM D3676]. Do not exceed the maximum ash content of 50 percent when tested in accordance with ASTM D297. Pass the accelerated aging test in accordance with [ASTM D3676] [ASTM D1667] for the cushion.

2.2 PERFORMANCE REQUIREMENTS

2.2.1 Static Control

Provide static control to permanently regulate static buildup to less than [3.5] [2.0] [_____] kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.

2.2.2 Flammability and Critical Radiant Flux Requirements

Comply with 16 CFR 1630. Provide carpet in corridors and exits with a minimum average critical radiant flux of [0.22] [0.45] watts per square centimeter when tested in accordance with ASTM E648.

2.2.3 Tuft Bind

comply with ASTM D1335 for tuft bind force required to pull a tuft or loop free from carpet backing with a minimum [10 pound average force for loop pile broadloom] [3 pound average force for cut pile broadloom] [8 pound average force for modular carpet tile].

2.2.4 Colorfastness to Crocking

Comply dry and wet crocking with AATCC 165 and with a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

2.2.5 Colorfastness to Light

Comply colorfastness to light with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and with a minimum 4 grey scale rating after 40 hours.

2.2.6 Colorfastness to Water

Comply colorfastness to water with AATCC 107 and with a minimum 4.0 gray scale rating and a minimum 4.0 transfer scale rating.

2.2.7 Delamination Strength

Provide delamination strength for tufted carpet with a secondary back of minimum 2.5 lbs/inch.

2.2.8 Antimicrobial

Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.

2.3 CARPET CUSHION

[2.3.1 Fiber Cushion

[Rubberized hair, mothproofed and sterilized] [Rubberized jute, mothproofed and sterilized] [Synthetic] [Resinated, recycled textile]

2.3.1.1 Weight

[ ] oz./sq. yd.

2.3.1.2 Thickness

[ ] inches plus 5 percent maximum

2.3.1.3 Density

[ ] lb/cu.ft.

][2.3.2 Rubber Cushion

[Flat][Rippled waffle][Textured flat][Reinforced]

2.3.2.1 Weight

[ ] oz./sq. yd.

2.3.2.2 Thickness

[ ] inches plus 5 percent maximum

2.3.2.3 Compression Resistance

[ ] kg/sq. mm[ ] lb/sq. in. at [25][65] percent in accordance with ASTM D3574.

2.3.2.4 Density

[ ] lb/cu.ft.

][2.3.3 Polyurethane-Foam Cushion

[Grafted prime] [Densified] [Bonded] [Mechanically frothed]

2.3.3.1 Compression Force Deflection at 65 Percent

[ ] lb/sq.in. of polymer density in accordance with ASTM D3574

2.3.3.2 Thickness

[ ] inches plus 5 percent maximum

2.3.3.3 Density

[ ] kg/cu.m[ ] lb/cu.ft.

]2.3.4 Performance Requirements - Critical Radiant Flux

Provide carpet cushion in corridors and exits with a minimum average critical radiant flux of [0.22][0.45] watts per square centimeter when tested in accordance with ASTM E648.

2.4 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers shall comply with applicable regulations regarding toxic and hazardous materials. Provide water resistant, mildew resistant, nonflammable, and nonstaining adhesives and concrete primers for carpet installation as required by the carpet manufacturer. Provide release adhesive for modular tile carpet as recommended by the carpet manufacturer. Provide adhesives flashpoint of minimum 140 degrees F in accordance with ASTM D3278.

2.5 MOLDINGS

Install carpet moldings where floor covering material changes or carpet edge does not abut a vertical surface. Provide an aluminum molding, pinless clamp-down type, designed for the type of carpet being installed. Provide [natural color anodized] [prefinished color [_____] finish.

Provide a floor flange of a minimum 1-1/2 inch wide and face a minimum 5/8 inch wide.] [a heavy-duty [vinyl] [rubber] molding designed for the type of carpet being installed. Provide floor flange of a minimum [1 1/2 inches] wide. Provide [_____] color to match [resilient base] [_____]].

2.6 TAPE

Provide tape for seams as recommended by the carpet manufacturer for the type of seam used in installation. Any seam sealant shall have a maximum VOC content of 50 grams/liter. Do not use sealants that contain 1,1,1-trichloroethane or toluene.

2.7 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with [Section 09 06 90 COLOR SCHEDULE] [the drawings] [_____].

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond. Submit [three] [_____] copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab for moisture content and excessive alkalinity in accordance with CRI CIS. Submit [three] [_____] copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting until concrete substrate is at least 90 days old. Prepare the concrete surfaces in accordance with the carpet manufacturer's instructions. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling agents, and concrete sealer.

3.4 INSTALLATION

Isolate area of installation from rest of building. Perform all work by manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI CIS. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Use autofoam mothproofing system for wool carpets. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation.

Complete other work which would damage the carpet prior to installation of carpet. Submit [three] [_____] copies of installation drawings for 1) Carpet, 2) Carpet Cushion, and 3) Moldings indicating areas receiving carpet, carpet types, patterns, direction of pile, location of seams, and locations of edge molding.

3.4.1 Broadloom Installation

Install broadloom carpet [direct glue down] [pre-applied adhesive glue down] smooth, uniform, and secure, with a minimum of seams. Apply regular, unnoticeable, and treated seams with a seam adhesive. Run side seams toward the light, where practical, and where such layout does not increase the number of seams. Install breadths parallel, with carpet pile in the same direction. Match patterns accurately. Neatly cut and fit cutouts, at door jambs, columns and ducts securely. Locate seams at doorways parallel to and centered directly under doors. Do not make seams perpendicular to doors or at pivot points. Provide seams at changes in directions of corridors to follow the wall line parallel to the carpet direction. Lay the carpet lengthwise down the corridors with widths less than 6 feet.

3.4.2 Modular Tile Installation

Install modular tiles with [permanent vinyl-compatible] [_____] adhesive and snug joints. Use [monolithic] [1/4 turn] [ashlar] [brick] [random] [ ] installation method. Provide accessibility to the subfloor where required.

3.4.3 Entrance Carpet Installation

[Install tiles with [permanent vinyl-compatible] [release] adhesive and snug joints. Use [monolithic] [1/4 turn] [ashlar] [brick] [random] installation method.] [Install roll goods [direct glue down] [pre-applied adhesive glue down] and smooth, uniform, and secure, with a minimum of seams. Prepare regular, unnoticeable, and treated seams with a seam adhesive. Install breadths parallel, with carpet pile in the same direction. Match patterns accurately. Neatly cut and fit, securely, cutouts at door jambs, columns, and ducts. Locate seams at doorways parallel to and centered directly under doors. Do not make seams perpendicular to doors or at pivot points.] [Cut mats to specified size and finish them with a tapered vinyl edge that is glued and sewn on.]

[3.4.4 Stretch-in Installation

Provide carpet tack strips wherever carpeting abuts vertical surfaces. Install tackless carpet stripping by nailing. Place carpet cushion face-up, as recommended by cushion manufacturer, over entire floor area to be carpeted with joints butted. Do not use adhesives to attach carpet, cushion, or substrate. Comply with carpet manufacturer's instructions for installation. Attach rubber or metal edge strip to substrate with adhesive for transition when carpet meets other flooring materials or to finish carpet edge when required.

]3.5 CLEANING AND PROTECTION

Submit [three] [_____] copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

3.5.1 Cleaning

As specified in Section 01 78 00 CLOSEOUT SUBMITTALS. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the Contracting Officer.

3.6 REMNANTS

Manage waste as specified in the Waste Management Plan. [Provide remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total [to the Government] [to local non-profit such as Habitat for Humanity as directed by the Government]]. [Non-retained scraps shall be set aside and returned to manufacturer for recycling into new product] [Remove non-retained scraps from site and recycle appropriately].

3.7 MAINTENANCE

3.7.1 Extra Materials

Provide extra material from same dye lot consisting of [full width continuous broadloom] [and] [uncut carpet tiles] for future maintenance. Provide a minimum of [_____] percent of total square yards of each carpet type, pattern, and color.

3.7.2 Maintenance Service

Collect information from the manufacturer about [maintenance agreement] [green lease] options, and submit to Contracting Officer. Service shall reclaim materials for recycling and/or reuse. Service shall not landfill or burn reclaimed materials. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation of manufacturer's [maintenance agreement] [take-back program] [green lease] for carpet. Include contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

-- 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

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007; R 2013) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D235	(2002; R 2012) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D2824/D2824M	(2013) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos
ASTM D4214	(2007) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D4263	(1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4444	(2013) Use and Calibration of Hand-Held Moisture Meters
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 E2129	(2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products

ASTM F1869	(2011) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 1	(Oct 2009) Aluminum Paint
MPI 10	(Oct 2009) Exterior Latex, Flat, MPI Gloss Level 1
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 116	(Oct 2009) Epoxy Block Filler
MPI 119	(Oct 2009) Exterior Latex, Gloss
MPI 13	(Oct 2009) Exterior Solvent-Based Semi-Transparent Stain
MPI 134	(Oct 2009) Galvanized Primer (Waterbased)
MPI 138	(Oct 2009) Interior High Performance Latex, MPI Gloss Level 2
MPI 139	(Oct 2009) Interior High Performance Latex, MPI Gloss Level 3
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 144	(Oct 2009) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 2
MPI 145	(Oct 2009) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 3
MPI 146	(Oct 2009) Institutional Low Odor/VOC Interior Latex, MPI Gloss Level 4
MPI 147	(Oct 2009) Institutional Low Odor / VOC Interior Latex, Semi-Gloss, MPI Gloss Level 5

MPI 151	(Oct 2009) Interior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 153	(Oct 2009) Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 154	(Oct 2009) Interior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 16	(Oct 2009) Exterior Latex-Based Solid Hide Stain
MPI 161	(Oct 2009) Exterior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 163	(Oct 2009) Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 164	(Oct 2009) Exterior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 19	(Oct 2009) Inorganic Zinc Rich Primer
MPI 2	(Oct 2009) Aluminum Heat Resistant Enamel (up to 427 C and 800 F
MPI 21	(Oct 2009) Heat Resistant Enamel, Gloss (up to 205 degrees C and 400 degrees F), MPI Gloss Level 6
MPI 22	(Oct 2009) Aluminum Paint, High Heat (up to 590 degrees C and 1100 degrees F.
MPI 23	(Oct 2009) Surface Tolerant Metal Primer
MPI 26	(Oct 2009) Cementitious Galvanized Metal Primer
MPI 27	(Oct 2009) Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 31	(Oct 2009) Polyurethane, Moisture Cured, Clear Gloss
MPI 39	(Oct 2009) Interior Latex-Based Wood Primer
MPI 4	(Oct 2009) Interior/Exterior Latex Block Filler
MPI 42	(Oct 2009) Latex Stucco and Masonry Textured Coating
MPI 44	(Oct 2009) Interior Latex, MPI Gloss Level 2
MPI 45	(Oct 2009) Interior Alkyd Primer Sealer
MPI 46	(Oct 2009) Interior Enamel Undercoat

MPI 47	(Oct 2009) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 48	(Oct 2009) Interior Alkyd, Gloss, MPI Gloss Level 6
MPI 49	(Oct 2009) Interior Alkyd, Flat, MPI Gloss Level 1
MPI 5	(Oct 2009) Exterior Alkyd Wood Primer
MPI 50	(Oct 2009) Interior Latex Primer Sealer
MPI 51	(Oct 2009) Interior Alkyd, Eggshell, MPI Gloss Level 2
MPI 52	(Oct 2009) Interior Latex, MPI Gloss Level 3
MPI 54	(Oct 2009) Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 56	(Oct 2009) Interior Oil Modified Urethane Clear Gloss
MPI 57	(Oct 2009) Interior Oil Modified Urethane Clear Satin
MPI 59	(Oct 2009) Interior/Exterior Floor Enamel, Low Gloss
MPI 6	(Oct 2009) Exterior Latex Wood Primer
MPI 60	(Oct 2009) Interior/Exterior Latex Floor Paint, Low Gloss
MPI 68	(Oct 2009) Interior/Exterior Latex Floor Enamel, Gloss
MPI 7	(Oct 2009) Exterior Oil Wood Primer
MPI 71	(Oct 2009) Polyurethane, Moisture Cured, Clear, Flat
MPI 72	(Oct 2009) Polyurethane, Two Component, Pigmented, Gloss
MPI 77	(Oct 2009) Epoxy Gloss
MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer
MPI 8	(Oct 2009) Exterior Alkyd, Flat, MPI Gloss Level I
MPI 9	(Oct 2009) Exterior Alkyd, Gloss, MPI Gloss Level 6

MPI 90	(Oct 2009) Interior Wood Stain, Semi-Transparent
MPI 94	(Oct 2009) Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 95	(Oct 2009) Quick Drying Primer for Aluminum

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage
SCS SP-01	(2000) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007; E 2004) Brush-Off Blast Cleaning
SSPC Guide 6	(2004) Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC Guide 7	(2004; E 2004) Guide to the Disposal of Lead-Contaminated Surface Preparation Debris
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 Paint 18	(1982; E 2004) Chlorinated Rubber Intermediate Coat Paint
SSPC QP 1	(1998; E 2004) Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/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
SSPC VIS 4/NACE VIS 7	(1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-680	(2010; Rev C) Degreasing Solvent
MIL-STD-101	(2014; Rev C) Color Code for Pipelines & for Compressed Gas Cylinders

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	(2000) Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

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

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
FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

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

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1001	Asbestos
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead

UL ENVIRONMENT (ULE)

ULE Greenguard UL Greenguard Certification Program

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. 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.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Certification

[Local/Regional Materials; (LEED NC)

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.]

[Environmental Data

] Materials; (LEED NC)

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar

value of products included in project.

Coating[; G][; G, [_____]]

Manufacturer's Technical Data Sheets; (LEED)

Indicate VOC content.

[Sealant]

SD-04 Samples

Color[; G][; G, [_____]]

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

[Textured Wall Coating System[; G][; G, [_____]]

Sample Textured Wall Coating System Mock-Up[; G][; G, [_____]]
]

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings[; G][; G, [_____]]

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][; G, [_____]]

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

SD-11 Closeout Submittals

[Local/Regional Materials; (LEED)

LEED documentation relative to local/regional materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.]

[Materials; (LEED)]

[LEED documentation relative to recycled content credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.]

[LEED documentation relative to low emitting materials credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.]

1.3 APPLICATOR'S QUALIFICATIONS

[1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on [_____] on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

]

[1.3.2 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an

inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

]1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

[Another required testing is Batch Quality Conformance Testing to prove conformance of the manufacturer's paint to the specified MPI standard. This testing is accomplished before the materials are delivered to the job site. Provide testing for [_____] paint products. Test paint products as specified in the paragraph "Testing Procedure".

]1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.4.2 Textured Wall Coating System

Three complete samples of each indicated type, pattern, and color of

textured wall coating system applied to a panel of the same material as that on which the coating system will be applied in the work. Samples of wall coating systems shall be minimum 5 by 7 inches and of sufficient size to show pattern repeat and texture.

1.4.3 Sample Textured Wall Coating System Mock-Up

After coating samples are approved, and prior to starting installation, a minimum 8 foot by 8 foot mock-up shall be provided for each substrate and for each color and type of textured wall coating, using the actual substrate materials. Once approved the mock-up samples shall be used as a standard of workmanship for installation within the facility. At least 48 hours prior to mock-up installation, the Contractor shall submit written notification to the Contracting Officer's Representative.

[1.4.4 Sustainable Design Certification

Product shall be third party certified in accordance with ULE Greenguard[Gold], SCS Scientific Certification Systems Indoor Advantage[Gold]or equal. Certification shall be performed annually and shall be current.

]1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to adsorb VOC emissions, [including [_____]]. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100, threshold limit values.

[d. The appropriate OSHA standard in 29 CFR 1910.1025 and 29 CFR 1926.62 for surface preparation on painted surfaces containing lead. Removal and disposal of coatings which contain lead is specified in [Section 02 83 19.00 10 LEAD BASED PAINT HAZARD ABATEMENT, TARGET HOUSING AND CHILD OCCUPIED FACILITIES][Section 02 83 13.00 20 LEAD IN CONSTRUCTION][Section 02 82 33.13 20 REMOVAL/CONTROL AND DISPOSAL OF PAINT WITH LEAD][_____]." Additional guidance is given in SSPC Guide 6 and SSPC Guide 7. Refer to drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.
]
[e. The appropriate OSHA standards in 29 CFR 1910.1001 for surface preparation of painted surfaces containing asbestos. Removal and disposal of coatings which contain asbestos materials is specified in [Section 02 82 16.00 20 ENGINEERING CONTROL OF ASBESTOS CONTAINING

MATERIALS][Section 02 82 14.00 10 ASBESTOS HAZARD CONTROL ACTIVITIES]. Refer to drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.

]1.8 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. [Isolate area of application from rest of building when applying high-emission paints or coatings.]

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.8.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 85 degrees F and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.9 SUSTAINABLE DESIGN REQUIREMENTS

1.9.1 Local/Regional Materials

[Use materials or products extracted, harvested, or recovered, as well as manufactured, within a [500][_____] mile radius from the project site, if available from a minimum of three sources.][See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total local material requirements. Paint and coating materials may be locally available.

]1.9.2 Environmental Data

[Submit Table 1 of ASTM E2129 for the following products: [_____].

]1.10 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs, including [_____].

1.11 COLOR SELECTION

[Color Coding For Shore-To-Ship Utility Connections: Paint hose connection fittings and shut-off valves the designated color. In addition to color coding provide 2 inch high stenciled letters using black stencil paint, clearly designating service for each connection.

Color Coding for Shore-to-Ship Utility Connections

Service	Color	FED-STD-595 No.
Potable Water*	Blue	15044
Water Provided for Fire Protection**	Red	11105
Chilled Water	Striped Blue/White	15044/17886
Oily Waste Water	Striped Yellow/Black	13538/17038
Sewer	Gold	17043
Steam	White	17886
High Pressure Air	Gray	16081
Low Pressure Air	Tan	10324
Fuel	Yellow	13655

* This includes connections serving domestic functions.

** This includes non-potable salt water or, at some locations, fresh water connections provided for fire protection (may also include flushing and cooling requirements). Note: This does not include waterfront fire hydrants.

] Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be [as indicated][in accordance with Section 09 06 90 COLOR SCHEDULE] [_____].

1.12 LOCATION AND SURFACE TYPE TO BE PAINTED

1.12.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.12.1.1 Exterior Painting

Includes new surfaces[, existing coated surfaces,] [and] [existing uncoated surfaces,] of the building[s] and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.12.1.2 Interior Painting

Includes new surfaces[, existing uncoated surfaces,] [and] [existing coated surfaces] of the building[s] and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.12.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

[f. Surfaces in the following areas shall not be painted: [_____].

]1.12.3 Mechanical and Electrical Painting

Includes field coating of [interior] [and] [exterior] new [and existing] surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

[b. Do not paint the following, unless indicated otherwise:

[(1) New zinc-coated, aluminum, and copper surfaces under insulation

][(2) New aluminum jacket on piping

][(3) New interior ferrous piping under insulation.

]][1.12.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material. [In lieu of red enamel finish coat, provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals.]

b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems.

][1.12.4 Exterior Painting of Site Work Items

Field coat the following items:

	New Surfaces	Existing Surfaces
a.	[_____]	[_____]
b.	[_____]	[_____]
c.	[_____]	[_____]

]1.12.5 MISCELLANEOUS PAINTING

Lettering [Building][Room Number(s)]

Lettering shall be provided as scheduled on the drawings, shall be [block] [Gothic] type, and shall be [black enamel] [water-type decalcomania,

finished with a protective coating of spar varnish]. Samples shall be approved before application.

[Obstructions To Aviation

The following obstructions to aviation shall be painted in the pattern and color prescribed by [FAA AC 70/7460-1] [_____]

]1.12.6 Definitions and Abbreviations

1.12.6.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.12.6.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.12.6.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.12.6.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.12.6.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.12.6.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.12.6.7 EXT

MPI short term designation for an exterior coating system.

1.12.6.8 INT

MPI short term designation for an interior coating system.

1.12.6.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.12.6.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.12.6.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.12.6.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units 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).

1.12.6.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.12.6.14 Paint

See Coating definition.

1.12.6.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.12.6.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents. [Minimum [20][50][_____] percent post-consumer recycled content for the following light-colored paints and primers: [_____]. Minimum [50][90][99][_____] percent post-consumer recycled content for the following dark-colored paints and primers: [_____]. [All][The following] consolidated latex paints shall contain a minimum of [100][_____] percent post-consumer recycled content[: [_____]].] Comply with applicable regulations regarding toxic and hazardous materials.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

[3.2 REPUTTYING AND REGLAZING

Remove cracked, loose, and defective putty or glazing compound on glazed sash and provide new putty or glazing compound. Where defective putty or glazing compound constitutes 30 percent or more of the putty at any one light, remove the glass and putty or glazing compound and reset the glass. Remove putty or glazing compound without damaging sash or glass. Clean rabbets to bare wood or metal and prime prior to reglazing. Putty for wood sash shall be a linseed oil putty. Patch surfaces to provide smooth transition between existing and new surfaces. Finish putty or glazing compound to a neat and true bead. Allow glazing compound time to cure, in accordance with manufacturer's recommendation, prior to coating application. Allow putty to set one week prior to coating application.

][3.3 RESEALING OF EXISTING EXTERIOR JOINTS

3.3.1 Surface Condition

Surfaces shall be clean, dry to the touch, and free from frost and moisture; remove grease, oil, wax, lacquer, paint, defective backstop, or other foreign matter that would prevent or impair adhesion. Where adequate grooves have not been provided, clean out to a depth of 1/2 inch and grind to a minimum width of 1/4 inch without damage to adjoining work. Grinding shall not be required on metal surfaces.

3.3.2 Backstops

In joints more than 1/2 inch deep, install glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free of oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

3.3.3 Primer and Bond Breaker

Install the type recommended by the sealant manufacturer.

3.3.4 Ambient Temperature

Between 38 degrees F and 95 degrees F when applying sealant.

3.3.5 Exterior Sealant

For joints in vertical surfaces, provide ASTM 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. Color(s) shall be selected by the Contracting Officer. Apply the sealant in accordance with the manufacturer's printed instructions. Force sealant into joints with sufficient pressure to fill the joints solidly. Sealant shall be uniformly smooth and free of wrinkles.

3.3.6 Cleaning

Immediately remove fresh sealant from adjacent areas using a solvent recommended by the sealant manufacturer. Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean condition. Allow sealant time to cure, in accordance with manufacturer's recommendations, prior to coating.

]3.4 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, [disintegrated coatings,] and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

[3.4.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, refer to paragraph Toxic Materials.

b. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry

cloth saturated with mineral spirits, ASTM D235. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

c. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

d. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

e. Previously painted surfaces [specified to be repainted] [damaged during construction] shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.

f. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

g. Chalk shall be removed so that when tested in accordance with ASTM D4214, the chalk resistance rating is no less than 8.

h. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.

i. Edges of chipped paint shall be feather edged and sanded smooth.

j. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.

k. New, proposed coatings shall be compatible with existing coatings.

][3.4.2 Existing Coated Surfaces with Minor Defects

[Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings.] [Remove chalking by sanding [or blasting] so that when tested in accordance with ASTM D4214, the chalk rating is not less than 8.]

][3.4.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

a. Surfaces containing large areas of minor defects;

b. Surfaces containing more than 20 percent peeling area; and

c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

][3.4.4 Substrate Repair

a. Repair substrate surface damaged during coating removal;

b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

c. Clean and prime the substrate as specified.

]3.5 PREPARATION OF METAL SURFACES

3.5.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: [Solvent clean] [or] [detergent wash] in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to [SSPC SP 2], [SSPC SP 3], [SSPC SP 6/NACE No.3], or [SSPC SP 10/NACE No. 2]. [Brush-off blast remaining surface in accordance with SSPC 7/NACE No.4]; [Water jetting to SSPC SP 12/NACE No.5 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting.] Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with [SSPC SP 6/NACE No.3/SSPC SP 12/NACE No.5 WJ-3][SSPC SP 10/NACE No. 2/ SSPC SP 12/NACE No.5 WJ-2].

[c. Metal Floor Surfaces to Receive Nonslip Coating: Clean in accordance with [SSPC SP 10/NACE No. 2][SSPC SP 12/NACE No.5 WJ-2].

]3.5.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC 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.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12/NACE No.5. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4/NACE VIS 7.

3.5.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with [solvent,][steam,][or][non-alkaline detergent solution]in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM 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: [Water jet to SSPC SP 12/NACE No.5 WJ3 degree of cleanliness.] [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.]

3.5.4 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.

3.5.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D235. Wipe dry with clean, dry cloths.

3.5.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.6 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.6.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, [Chalking,] Grease, and Oil: Wash new [and existing uncoated] surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cuphousehold detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. [Wash existing coated surfaces with a suitable detergent and rinse thoroughly.] For large areas, water blasting may be used.

(2) Fungus and Mold: Wash [new] [, existing coated,] [and existing uncoated] surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

[(5) Removal of Existing Coatings: For surfaces to receive textured coating MPI 42, remove existing coatings including soundly adhered coatings if recommended by textured coating manufacturer.

] c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM 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.

3.6.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.6.3 Existing Asbestos Cement Surfaces

Remove oily stains by solvent cleaning with mineral spirits, [MIL-PRF-680][ASTM D235]. Remove loose dirt, dust, and other deleterious substances by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material. Do not wire brush or clean using other abrasive methods. Surfaces shall be dry and clean prior to application of the coating.

3.7 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.7.1 New [, Existing Uncoated,] [and] [Existing Coated] Plywood and Wood Surfaces, Except Floors:

a. Wood surfaces shall be cleaned of foreign matter.

Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. [Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.]

[b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

] c. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D4444, Method A, unless otherwise authorized.

d. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

f. Cosmetic Repair of Minor Defects:

(1) Knots and Resinous Wood [and Fire, Smoke, Water, and Color Marker Stained Existing Coated Surface]: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

(2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

(3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

g. Prime Coat For New Exterior Surfaces: Prime coat [wood doors,] [windows,] [frames,] [and] [trim] before wood becomes dirty, warped, [or weathered].

3.7.2 Wood Floor Surfaces, Natural Finish

a. Initial Surface Cleaning: As specified in paragraph entitled "Surface Preparation."

[b. Existing Loose Boards and Shoe Molding: Before sanding, renail loose boards. Countersink nails and fill with an approved wood filler. Remove shoe molding before sanding and reinstall after completing other work. At Contractor's option, new shoe molding may be provided in lieu of reinstalling old. New wood molding shall be same size, wood species, and finish as the existing.

] c. Sanding and Scraping: Sanding of wood floors is specified in Section [09 64 29 WOOD STRIP FLOORING] [09 64 23 WOOD PARQUET FLOORING] [09 64 66 WOOD ATHLETIC FLOORING] [09 64 00 PORTABLE (DEMOUNTABLE) WOOD FLOORING]. Floors of oak or similar open-grain wood shall be filled with wood filler recommended by the finish manufacturer and the excess filler removed.

d. Final Cleaning: After sanding, sweep and vacuum floors clean. Do not walk on floors thereafter until specified sealer has been applied and is dry.

3.7.3 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not

less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

3.7.4 Water Blasting of Existing Coated Wood Surfaces:

Water blasting shall be provided for the following surfaces: [_____].

a. Sample Panel: Prior to the initial surface cleaning, water blast a representative surface designated by the Contracting Officer. Final surface condition of remaining work shall be similar to sample panel approved by the Contracting Officer.

b. Initial Surface Cleaning: Water blasting shall consist of washing surfaces to receive paint with a high pressure spray, to remove loose paint, dirt, and other foreign or deleterious materials. The working pressure shall be between 400 and 700 pounds per square inch gage (psig) at a nozzle operating rate of a minimum 20 gallons per minute (g/min.). Do not flood vents or damage windows and floors. If the pressure specified will cause damage to existing wood, advise the Contracting Officer and obtain permission to vary the pressure. Direct the wash nozzle at the surface at an angle of approximately 75 degrees with the surface and at a distance not greater than 5 feet to apply water pressure required to remove loose paint, dirt, chalking, and other foreign matter.

c. Final Surface Cleaning: After allowing the surfaces to dry for a minimum of 24 hours, remove remaining dirt, splinters, loose particles, disintegrated and loose paint, grease, oil, and other foreign matter from the surface.

3.8 APPLICATION

3.8.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other

voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats.[Interior areas shall be broom clean and dust free before and during the application of coating material.]

[Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 1.0 mil. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

] a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

e. Floors: [For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat.] [For nonslip surfacing on ramps, provide MPI 77 with non-skid additive, applied by roller in accordance with manufacturer's instructions.]

3.8.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than [0.125 L] [1 pint] of suitable thinner per [liter.] [gallon.] The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.8.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.8.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table
Division 9: Exterior Stucco Paint Table
Division 10. Exterior Cloth Coverings and Bituminous Coated Surfaces Paint Table

Division 3. Interior Concrete Paint Table
Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces

where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.9 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.10 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.11 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood [and plywood] surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

[d. Wood Floors to Receive Natural Finish: Thin first coat 2 to 1 using thinner recommended by coating manufacturer. Apply all coatings at rate of 300 to 350 square feet per gallon. Apply second coat not less than 2 hours and not over 24 hours after first coat has been applied. Apply with lambs wool applicators or roller as recommended by coating manufacturer. Buff or lightly sand between intermediate coats as recommended by coating manufacturer's printed instructions.

]3.12 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with [MIL-STD-101][ASME A13.1]. Place stenciling in clearly visible locations. On piping not covered by [MIL-STD-101][ASME A13.1], stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black

stencil paint.

3.13 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.14 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. [Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, local recyclers shall be sought after to reclaim the materials.] [Set aside extra paint for future color matches or reuse by the Government.] [Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local organizations.]

3.15 PAINT TABLES

All DFT's are minimum values.[Use only materials [with a GPS green check mark] having a minimum MPI "Environmentally Friendly" [E1] [E2] [E3] rating based on VOC (EPA Method 24) content levels.][Use only interior paints and coatings that meet VOC requirements of LEED low emitting materials credit.] Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.15.1 EXTERIOR PAINT TABLES

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

A. [New and uncoated existing] [and Existing, previously painted] concrete; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. [Latex
[New; MPI EXT 3.1A-G2 (Flat) / Existing; MPI REX 3.1A-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 10 MPI 10 MPI 10
System DFT: 3.5 mils]

[New; MPI EXT 3.1A-G5 (Semigloss) / Existing; MPI EXT 3.1A-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 11 MPI 11 MPI 11
System DFT: 3.5 mils]

[New; MPI EXT 3.1A-G6 (Gloss) / Existing; MPI REX 3.1A-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 119 MPI 119 MPI 119
System DFT: 3.5 mils]

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.]

B. [New and uncoated existing] [and Existing, previously painted] concrete, textured system; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. [Latex Aggregate
[New; MPI EXT 3.1B-G2 (Flat) / Existing; MPI REX 3.1B-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 42 MPI 10 MPI 10
System DFT: Per Manufacturer]

[New; MPI EXT 3.1B-G5 (Semigloss) / Existing; MPI REX 3.1B-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 42 MPI 11 MPI 11
System DFT: Per Manufacturer]

[New; MPI EXT 3.1B-G6 (Gloss) / Existing; MPI REX 3.1B-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 42 MPI 119 MPI 119
System DFT: Per Manufacturer]

Texture - [Fine] [Medium] [Coarse]. Surface preparation and number of coats in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.]

C. [New and uncoated existing] [and Existing, previously painted] concrete, elastomeric System; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. [Elastomeric Coating
New; MPI EXT 3.1F / Existing; MPI REX 3.1F
Primer: Intermediate: Topcoat:
Per Manufacturer MPI 113 MPI 113
System DFT: 16 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions.

NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 16 mils.]

D. [New and uncoated existing] [and Existing, previously painted] concrete: walls and bottom of swimming pools.

1. [Chlorinated Rubber
New; / Existing;
Primer: Intermediate: Topcoat:
SSPC Paint 18 SSPC Paint 18 SSPC Paint 18
System DFT: Per Manufacturer

NOTE: Thin first coat (primer) with 1 part of approved thinner to 4 parts of paint by volume.]

E. [New] [and Existing] Cementitious composition board (including Asbestos

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE
cement board):

1. [Latex
[New; MPI EXT 3.3A-G1 (Flat) /Existing; MPI REX 3.3A-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 10 MPI 10 MPI 10
System DFT: 4.5 mils]

[New; MPI EXT 3.3A-G5 (Semigloss) / Existing; MPI REX 3.3A-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 11 MPI 11 MPI 11
System DFT: 4.5 mils]

[New; MPI EXT 3.3A-G6 (Gloss) / Existing; MPI REX 3.3A-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 119 MPI 119 MPI 119
System DFT: 4.5 mils]

Topcoat: Coating to match adjacent surfaces.]

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. [New] [and Existing] concrete masonry on uncoated surface:

1. [Latex
[New; MPI EXT 4.2A-G1 (Flat) / Existing; MPI REX 4.2A-G1 (Flat)
Block Filler: Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 10 MPI 10
System DFT: 11 mils]

[New; MPI EXT 4.2A-G5 (Semigloss) / Existing; MPI REX 4.2A-G5 (Semigloss)
Block Filler: Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 11 MPI 11
System DFT: 11 mils]

[New; MPI EXT 4.2A-G6 (Gloss) / Existing; MPI REX 4.2A-G6 (Gloss)
Block Filler: Primer: Intermediate: Topcoat:
MPI 4 N/A MPI 119 MPI 119
System DFT: 11 mils]

Topcoat: Coating to match adjacent surfaces.]

B. [New] [and Existing] concrete masonry, textured system; on uncoated surface:

1. [Latex Aggregate
[New; MPI EXT 4.2B-G1 (Flat) / Existing; MPI REX 4.2B-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 42 MPI 42 MPI 10
System DFT: Per Manufacturer]

[New; MPI EXT 4.2B-G5 (Semigloss) / Existing; MPI REX 4.2B-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 42 MPI 42 MPI 11
System DFT: Per Manufacturer]

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

[New; MPI EXT 4.2B-G6 (Gloss) / Existing; MPI REX 4.2B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 42	MPI 42	MPI 119

System DFT: Per Manufacturer]

Texture - [Fine] [Medium] [Coarse]. Surface preparation and number of coats in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.]

C. [New] [and Existing] concrete masonry, elastomeric system; on uncoated surface:

1. [Elastomeric Coating

New; MPI EXT 4.2D / Existing; MPI REX 4.2D

Primer:	Intermediate:	Topcoat:
Per Manufacturer	MPI 113	MPI 113

System DFT: 16 mils

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions.

NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 16 mils.]

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. [Alkyd

[New; MPI EXT 5.1Q-G5 (Semigloss) Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 94	MPI 94

System DFT: 5.25 mils]

[New; MPI EXT 5.1Q-G6 (Gloss) / Existing; MPI REX 5.1D-G6

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 9	MPI 9

System DFT: 5.25 mils]]

B. New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3:

2. [Alkyd

[New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 94	MPI 94

System DFT: 5.25 mils]

[New; MPI EXT 5.1D-G6 (Gloss) / Existing; MPI REX 5.1D-G6

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 9	MPI 9

System DFT: 5.25 mils]]

C. Existing steel that has been spot-blasted to SSPC SP 6/NACE No.3:

STEEL / FERROUS SURFACES

1. [Surface previously coated with alkyd or latex:

   [Waterborne Light Industrial Coating
   MPI REX 5.1C-G5 (Semigloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 79 MPI 163 MPI 163
   System DFT: 5 mils]

   [MPI REX 5.1C-G6 (Gloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 79 MPI 164 MPI 164
   System DFT: 5 mils]]

2. [Surface previously coated with epoxy:

   [Waterborne Light Industrial
   a. MPI REX 5.1L-G5 (Semigloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 101 MPI 163 MPI 163
   System DFT: 5 mils]

   [MPI REX 5.1L-G6 (Gloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 101 MPI 164 MPI 164
   System DFT: 5 mils]

   [Pigmented Polyurethane
   b. MPI REX 5.1H-G6 (Gloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 101 MPI 108 MPI 72
   System DFT: 8.5 mils]]

D. New [and existing] steel blast cleaned to SSPC SP 10/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]

   [MPI EXT 5.1R-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 101 MPI 108 MPI 164
   System DFT: 8.5 mils]]

2. [Pigmented Polyurethane
   MPI EXT 5.1J-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 101 MPI 108 MPI 72
   System DFT: 8.5 mils]

E. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. [Alkyd Floor Enamel
   MPI EXT 5.1S-G6 (Gloss)
   Primer: Intermediate: Topcoat:

STEEL / FERROUS SURFACES
MPI 79 MPI 27 MPI 27 (plus NSA)
System DFT: 5.25 mils]

EXTERIOR GALVANIZED SURFACES

F. New Galvanized surfaces:

1. [Cementitious primer / Latex
[MPI EXT 5.3A-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 26 MPI 10 MPI 10
System DFT: 4.5 mils]

[MPI EXT 5.3A-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 26 MPI 11 MPI 11
System DFT: 4.5 mils]

[MPI EXT 5.3A-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 26 MPI 119 MPI 119
System DFT: 4.5 mils]]

2. [Waterborne Primer / Latex
[MPI EXT 5.3H-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 134 MPI 10 MPI 10
System DFT: 4.5 mils]

[MPI EXT 5.3H-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 11 MPI 11
System DFT: 4.5 mils]

[MPI EXT 5.3H-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 119 MPI 119
System DFT: 4.5 mils]]

3. [Waterborne Primer / Waterborne Light Industrial Coating
[MPI EXT 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 163 MPI 163
System DFT: 4.5 mils]

[MPI EXT 5.3J-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 164 MPI 164
System DFT: 4.5 mils]]

4. [Epoxy Primer / Waterborne Light Industrial Coating
[MPI EXT 5.3K-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 163 MPI 163
System DFT: 5 mils]

[MPI EXT 5.3K-G6 (Gloss)
Primer: Intermediate: Topcoat:

EXTERIOR GALVANIZED SURFACES
MPI 101 MPI 164 MPI 164
System DFT: 5 mils]]

5. [Pigmented Polyurethane
MPI EXT 5.3L-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 101 N/A MPI 72
System DFT: 5 mils]

G. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. [Waterborne Light Industrial Coating
MPI REX 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 N/A MPI 163
System DFT: 4.5 mils]

2. [Pigmented Polyurethane
MPI REX 5.3D-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 101 N/A MPI 72
System DFT: 5 mils]

H. Galvanized surfaces with severely deteriorated coating or rusting:

1. [Waterborne Light Industrial Coating
[MPI REX 5.3L-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 163
System DFT: 8.5 mils]

[MPI REX 5.3L-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 164
System DFT: 8.5 mils]]

2. [Pigmented Polyurethane
MPI REX 5.3K-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 72
System DFT: 5 mils]

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

I. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. [Alkyd
[MPI EXT 5.4F-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 95 MPI 8 MPI 8
System DFT: 5 mils]

[MPI EXT 5.4F-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 94 MPI 94

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)
System DFT: 5 mils]

[MPI EXT 5.4F-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 9 MPI 9
System DFT: 5 mils]]

2. [Waterborne Light Industrial Coating
[MPI EXT 5.4G-G3(Eggshell)
Primer: Intermediate: Topcoat:
MPI 95 MPI 161 MPI 161
System DFT: 5 mils]

[MPI EXT 5.4G-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 163 MPI 163
System DFT: 5 mils]

[MPI EXT 5.4G-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 164 MPI 164
System DFT: 5 mils]]

I. Existing roof surfaces previously coated:

1. [Aluminum Pigmented Asphalt Roof Coating
ASTM D2824/D2824M: Sufficient coats to provide not less than 8 mils of finished coating system (without asbestos fibers).]

2. [Aluminum Paint
MPI REX 10.2D
Primer: Intermediate: Topcoat:
MPI 107 MPI 1 MPI 1
System DFT: 3.5 mils]

J. Surfaces adjacent to painted surfaces; [Mechanical,] [Electrical,] [Fire extinguishing sprinkler systems including valves, conduit, hangers, supports,][exposed copper piping,] [and miscellaneous metal items] not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. [Alkyd
[MPI EXT 5.1D-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 79 MPI 8 MPI 8
System DFT: 5.25 mils]

[MPI EXT 5.1D-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 94 MPI 94
System DFT: 5.25 mils]

[MPI EXT 5.1D-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 9 MPI 9
System DFT: 5.25 mils]]

2. [Waterborne Light Industrial Coating

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)
[MPI EXT 5.1C-G3(Eggshell)
Primer: Intermediate: Topcoat:
MPI 79 MPI 161 MPI 161
System DFT: 5 mils]

[MPI EXT 5.1C-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 163 MPI 163
System DFT: 5 mils]

[MPI EXT 5.1C-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 164 MPI 164
System DFT: 5 mils]]

K. Hot metal surfaces [including smokestacks] subject to temperatures up to 400 degrees F:

1. [Heat Resistant Enamel
MPI EXT 5.2A
Primer: Intermediate: Topcoat:
MPI 21 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer]

L. Ferrous metal subject to high temperature, up to 750 degrees F:

1. [Inorganic Zinc Rich Coating
MPI EXT 5.2C
Primer: Intermediate: Topcoat:
MPI 19 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer]

2. [Heat Resistant Aluminum Enamel
MPI EXT 5.2B (Aluminum Finish)
Primer: Intermediate: Topcoat:
MPI 2 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer]

M. [New surfaces and] [Existing surfaces] made bare cleaning to SSPC SP 10/NACE No. 2
subject to temperatures up to 593 degrees C (1100 degrees F):

1. [Heat Resistant Coating
MPI EXT 5.2D
Primer: Intermediate: Topcoat:
MPI 22 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer]

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

A. New [and Existing, uncoated] Dressed lumber, Wood and plywood, trim, [including top, bottom and edges of doors] not otherwise specified:

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

1. [Alkyd
   [MPI EXT 6.3B-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 94 MPI 94
   System DFT: 5 mils]

   [MPI EXT 6.3B-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 9 MPI 9
   System DFT: 5 mils]]

2. [Latex
   [MPI EXT 6.3A-G1 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 10 MPI 10
   System DFT: 5 mils]

   [MPI EXT 6.3A-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 11 MPI 11
   System DFT: 5 mils]

   [MPI EXT 6.3A-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 119 MPI 119
   System DFT: 5 mils]]

3. [Waterborne Solid Color Stain
   MPI EXT 6.3K
   Primer: Intermediate: Topcoat:
   MPI 7 MPI 16 MPI 16
   System DFT: 4.25 mils]

B. Existing, dressed lumber, Wood and plywood, trim, [including top, bottom and edges of doors] previously coated with an alkyd / oil based finish coat not otherwise specified:

1. [Alkyd
   [MPI REX 6.3B-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 5 MPI 94 MPI 94
   System DFT: 5 mils]

   [MPI REX 6.3B-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 5 MPI 9 MPI 9
   System DFT: 5 mils]]

2. [Latex
   [MPI REX 6.3A-G1 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 5 MPI 10 MPI 10
   System DFT: 5 mils]

   [MPI REX 6.3A-G5 (Semigloss)
   Primer: Intermediate: Topcoat:

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

MPI 5 MPI 11 MPI 11
System DFT: 5 mils]

[MPI REX 6.3A-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 5 MPI 119 MPI 119
System DFT: 5 mils]]

C. Existing, dressed lumber, Wood and plywood, trim, [including top, bottom and edges of doors] previously coated with a latex / waterborne finish coat not otherwise specified:

1. [Latex
[MPI REX 6.3L-G1 (Flat)
Spot Primer: Intermediate: Topcoat:
MPI 6 MPI 10 MPI 10
System DFT: 4.5 mils]

[MPI REX 6.3L-G5 (Semigloss)
Spot Primer: Intermediate: Topcoat:
MPI 6 MPI 11 MPI 11
System DFT: 4.5 mils]

[MPI REX 6.3L-G6 (Gloss)
Spot Primer: Intermediate: Topcoat:
MPI 6 MPI 119 MPI 119
System DFT: 4.5 mils]]

2. [Waterborne Solid Color Stain
MPI REX 6.3K (Stain)
Spot Primer: Intermediate: Topcoat:
MPI 6 MPI 16 MPI 16
System DFT: 4 mils]

D. New, Uncoated wood siding:

1. [Semi-Transparent Stain
MPI EXT 6.3D
Spot Primer: Intermediate: Topcoat:
N/A MPI 13 MPI 13
System DFT: N/A]

E. Existing, previously stained wood siding:

1. [Latex
[MPI REX 6.2K-G1 (Flat)
Primer: Intermediate: Topcoat:
MPI 5 MPI 10 MPI 10
System DFT: 4.5 mils]

[MPI REX 6.2K-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 5 MPI 11 MPI 11
System DFT: 4.5 mils]]

F. Existing Uncoated or previously semitransparent stained wood siding:

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT TABLE

1. [Semi-Transparent Stain
   MPI REX 6.3D
   Spot Primer: Intermediate: Topcoat:
   N/A MPI 13 MPI 13
   System DFT: Per Manufacturer]

G. Wood: [Steps], [platforms], [floors of open porches], and [_____] [with non-skid additive (NSA), load at manufacturer's recommendations.]:

1. [Latex Floor Paint
   [MPI EXT 6.5A-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 5 MPI 60 [plus NSA] MPI 60 [plus NSA]
   System DFT: 4.5 mils]

   [MPI EXT 6.5A-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 5 MPI 68 [plus NSA] MPI 68 [plus NSA]
   System DFT: 4.5 mils]]

2. [Alkyd Floor Paint
   [MPI EXT 6.5B-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 59 MPI 59 [plus NSA] MPI 59 [plus NSA]
   System DFT: 5 mils]

   [MPI EXT 6.5B-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 27 MPI 27 [plus NSA] MPI 27 [plus NSA]
   System DFT: 5 mils]]

DIVISION 9: EXTERIOR STUCCO PAINT TABLE

A. [New] [and Existing] stucco:

1. [Latex
   [New; MPI EXT 9.1A-G1 (Flat) / Existing; MPI REX 9.1A-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 10 MPI 10 MPI 10
   System DFT: 4.5 mils]

   [New; MPI EXT 9.1A-G5 (Semigloss) / Existing; MPI REX 9.1A-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 11 MPI 11 MPI 11
   System DFT: 4.5 mils]

   [New; MPI EXT 9.1A-G6 (Gloss) / Existing; MPI REX 9.1A-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 119 MPI 119 MPI 119
   System DFT: 4.5 mils]

   Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. On existing stucco, apply primer based on surface condition.]

B. [New] [and Existing] stucco, elastomeric system:

DIVISION 9: EXTERIOR STUCCO PAINT TABLE

1. [Elastomeric Coating
   New; MPI EXT 9.1C / Existing; MPI REX 9.1C
   Primer: Intermediate: Topcoat:
   N/A MPI 113 MPI 113
   System DFT: 16 mils

   Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions).

   NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 16 mils.]

DIVISION 10: EXTERIOR CLOTH COVERINGS AND BITUMINOUS COATED SURFACES PAINT TABLE

A. Insulation and surfaces of insulation coverings (canvas, cloth, paper): (Interior and Exterior Applications)

1. [Latex
   [MPI EXT 10.1A-G1 (Flat)
   Primer: Intermediate: Topcoat:
   N/A MPI 10 MPI 10
   System DFT: 3.2 mils]

   [MPI EXT 10.1A-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   N/A MPI 11 MPI 11
   System DFT: 3.2 mils]

   [MPI EXT 10.1A-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   N/A MPI 119 MPI 119
   System DFT: 3.2 mils]

   Topcoat: Coating to match adjacent surfaces.]

3.15.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. [New and uncoated existing] [and Existing, previously painted] Concrete, vertical surfaces, not specified otherwise:

1. [Latex
   [New; MPI INT 3.1A-G2 (Flat) / Existing; MPI RIN 3.1A-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 50 MPI 44 MPI 44
   System DFT: 4 mils]

   [New; MPI INT 3.1A-G3 (Eggshell) / Existing; MPI RIN 3.1A-G3 (Eggshell)
   Primer: Intermediate: Topcoat:
   MPI 50 MPI 52 MPI 52
   System DFT: 4 mils]

   [New; MPI INT 3.1A-G5 (Semigloss) / Existing; MPI RIN 3.1A-G5 (Semigloss)
   Primer: Intermediate: Topcoat:

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

MPI 50 MPI 54 MPI 54
System DFT: 4 mils]]

2. [High Performance Architectural Latex
[New; MPI INT 3.1C-G2 (Flat) / Existing; MPI RIN 3.1J-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 50 MPI 138 MPI 138
System DFT: 4 mils]

[New; MPI INT 3.1C-G3 (Eggshell) / Existing; MPI RIN 3.1J-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 50 MPI 139 MPI 139
System DFT: 4 mils]

[New; MPI INT 3.1C-G4 (satin)/ Existing; MPI RIN 3.1J-G4
Primer: Intermediate: Topcoat:
MPI 50 MPI 140 MPI 140
System DFT: 4 mils]

[New; MPI INT 3.1C-G5 (Semigloss) / Existing; MPI RIN 3.1J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 141 MPI 141
System DFT: 4 mils]]

3. [Institutional Low Odor / Low VOC Latex
[New; MPI INT 3.1M-G2 (Flat) / Existing; MPI RIN 3.1L-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 50 MPI 144 MPI 144
System DFT: 4 mils]

[New; MPI INT 3.1M-G3 (Eggshell) / Existing; MPI RIN 3.1L-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 50 MPI 145 MPI 145
System DFT: 4 mils]

[New; MPI INT 3.1M-G4 (satin)/ Existing; MPI RIN 3.1L-G4
Primer: Intermediate: Topcoat:
MPI 50 MPI 146 MPI 146
System DFT: 4 mils]

[New; MPI INT 3.1M-G5 (Semigloss) / Existing; MPI RIN 3.1L-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 147 MPI 147
System DFT: 4 mils]]

B. Concrete ceilings, uncoated:

1. [Latex Aggregate
MPI INT 3.1N
Primer: Intermediate: Topcoat:
N/A N/A MPI 42
System DFT: Per Manufacturer

Texture - [Fine] [Medium] [Coarse]. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.]

C. [New and uncoated existing] [and Existing, previously painted] Concrete

DIVISION 3: INTERIOR CONCRETE PAINT TABLE
in [toilets], [food-preparation], [food-serving], [restrooms], [laundry areas], [shower areas], [areas requiring a high degree of sanitation], [_____] [and other high-humidity areas] not otherwise specified except floors:

1. [Waterborne Light Industrial Coating
[New; MPI INT 3.1L-G3(Eggshell) / Existing; MPI RIN 3.1C-G3(Eggshell)
Primer: Intermediate: Topcoat:
MPI 151 MPI 151 MPI 151
System DFT: 4.8 mils]

[New; MPI INT 3.1L-G5(Semigloss) / Existing; MPI RIN 3.1C-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 153 MPI 153 MPI 153
System DFT: 4.8 mils]

[New; MPI INT 3.1L-G6(Gloss) / Existing; MPI RIN 3.1C-G6(Gloss)
Primer: Intermediate: Topcoat:
MPI 154 MPI 154 MPI 154
System DFT: 4.8 mils]]

2. [Alkyd
[New; MPI INT 3.1D-G3 (Eggshell) / Existing; RIN 3.1D-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 50 MPI 51 MPI 51
System DFT: 4.5 mils]

[MPI INT 3.1D-G5 (Semigloss) / Existing; RIN 3.1D-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 47 MPI 47
System DFT: 4.5 mils]

[MPI INT 3.1D-G6 (Gloss) / Existing; RIN 3.1D-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 48 MPI 48
System DFT: 4.5 mils]]

3. [Epoxy
New; MPI INT 3.1F-G6 (Gloss) / Existing; MPI RIN 3.1E-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 77 MPI 77 MPI 77
System DFT: 4 mils

Note: Primer may be reduced for penetration per manufacturer's instructions.]

D. [New and uncoated existing] [and Existing, previously painted] concrete walls and bottom of swimming pools:

1. [Chlorinated Rubber
Primer: Intermediate: Topcoat:
SSPC Paint 18 SSPC Paint 18 SSPC Paint 18
System DFT: Per Manufacturer

Note: Primer may be reduced for penetration per manufacturer's instructions.]

2. [Epoxy

DIVISION 3: INTERIOR CONCRETE PAINT TABLE
New; MPI INT 3.1F / Existing; MPI RIN 3.1E

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

System DFT: 4 mils

Note: Primer may be reduced for penetration per manufacturer's instructions.]

E. [[New and uncoated existing] [and Existing, previously painted] concrete floors in following areas [_____]:

1. [Latex Floor Paint
New; MPI INT 3.2A-G2 (Flat) / Existing; MPI RIN 3.2A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 60	MPI 60	MPI 60

System DFT: 5 mils]

2. [Alkyd Floor Paint
New; MPI INT 3.2B-G2 (Flat) / Existing; MPI RIN 3.2B-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 59	MPI 59	MPI 59

System DFT: 5 mils]

3. [Epoxy
New; MPI INT 3.2C-G6 (Gloss) / Existing; MPI RIN 3.2C-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

System DFT: 5 mils]

Note: Primer may be reduced for penetration per manufacturer's instructions.]

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New [and uncoated Existing] Concrete masonry:

1. [High Performance Architectural Latex
[MPI INT 4.2D-G2 (Flat)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 138	MPI 138

System DFT: 11 mils]

[MPI INT 4.2D-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 139	MPI 139

System DFT: 11 mils]

[MPI INT 4.2D-G4 (Satin)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 140	MPI 140

System DFT: 11 mils]

[MPI INT 4.2D-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 141	MPI 141

System DFT: 11 mils]

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE
Fill all holes in masonry surface]

2. [Institutional Low Odor / Low VOC Latex
[New; MPI INT 4.2E-G2 (Flat)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 144	MPI 144

System DFT: 4 mils]

[New; MPI INT 4.2E-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 145	MPI 145

System DFT: 4 mils]

[New; MPI INT 4.2E-G4 (Satin)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 146	MPI 146

System DFT: 4 mils]

[New; MPI INT 4.2E-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 147	MPI 147

System DFT: 4 mils]]

B. Existing, previously painted Concrete masonry:

1. [High Performance Architectural Latex
[MPI RIN 4.2K-G2 (Flat)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 138	MPI 138

System DFT: 4.5 mils]

[MPI RIN 4.2K-G3 (Eggshell)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 139	MPI 139

System DFT: 4.5 mils]

[MPI RIN 4.2K-G4

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 140	MPI 140

System DFT: 4.5 mils]

[MPI RIN 4.2K-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 141	MPI 141

System DFT: 4.5 mils]]

2. [Institutional Low Odor / Low VOC Latex
[Existing; MPI RIN 4.2L-G2 (Flat)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 144	MPI 144

System DFT: 4 mils]

[Existing; MPI RIN 4.2L-G3 (Eggshell)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 145	MPI 145

System DFT: 4 mils]

[Existing; MPI RIN 4.2L-G4 (Satin)

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146
System DFT: 4 mils]		

[Existing; MPI RIN 4.2L-G5 (Semigloss)

Spot Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147
System DFT: 4 mils]]		

C. New [and uncoated Existing] Concrete masonry units in [toilets], [food-preparation], [food-serving], [restrooms], [laundry areas], [shower areas], [areas requiring a high degree of sanitation], [_____], [and other high humidity areas] unless otherwise specified:

1. [Waterborne Light Industrial Coating

[MPI INT 4.2K-G3(Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 151	MPI 151
System DFT: 11 mils]			

[MPI INT 4.2K-G5(Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 153	MPI 153
System DFT: 11 mils]			

[MPI INT 4.2K-G6(Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 154	MPI 154
System DFT: 11 mils]			

Fill all holes in masonry surface]

2. [Alkyd

[MPI INT 4.2N-G3 (Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 51	MPI 51
System DFT: 12 mils]			

[MPI INT 4.2N-G5 (Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 47	MPI 47
System DFT: 12 mils]			

[MPI INT 4.2N-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 48	MPI 48
System DFT: 12 mils]			

Fill all holes in masonry surface]

3. [Epoxy

MPI INT 4.2G-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 116	N/A	MPI 77	MPI 77
System DFT: 10 mils			

Fill all holes in masonry surface]

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

D. Existing, previously painted, concrete masonry units in [toilets], [food-preparation], [food-serving], [restrooms], [laundry areas], [shower areas], [areas requiring a high degree of sanitation], [_____], [and other high humidity areas] unless otherwise specified:

1. [Waterborne Light Industrial Coating
   [MPI RIN 4.2G-G3(Eggshell)
   Spot Primer: Intermediate: Topcoat:
   MPI 151 MPI 151 MPI 151
   System DFT: 4.5 mils]

   [MPI RIN 4.2G-G5(Semigloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 153 MPI 153 MPI 153
   System DFT: 4.5 mils]

   [MPI RIN 4.2G-G6(Gloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 154 MPI 154 MPI 154
   System DFT: 4.5 mils]]

2. [Alkyd
   [MPI RIN 4.2C-G3 (Eggshell)
   Spot Primer: Intermediate: Topcoat:
   MPI 50 MPI 51 MPI 51
   System DFT: 4.5 mils]

   [MPI RIN 4.2C-G5 (Semigloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 50 MPI 47 MPI 47
   System DFT: 4.5 mils]

   [MPI RIN 4.2C-G6 (Gloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 50 MPI 48 MPI 48
   System DFT: 4.5 mils]]

3. [Epoxy
   MPI RIN 4.2D-G6 (Gloss)
   Spot Primer: Intermediate: Topcoat:
   MPI 77 MPI 77 MPI 77
   System DFT: 5 mils]

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, [Mechanical,] [Electrical,] [Fire extinguishing sprinkler systems including valves, conduit, hangers, supports,][Surfaces adjacent to painted surfaces (Match surrounding finish),] [exposed copper piping,] [and miscellaneous metal items] not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. [High Performance Architectural Latex
   [MPI INT 5.1R-G2 (Flat)
   Primer: Intermediate: Topcoat:

INTERIOR STEEL / FERROUS SURFACES
MPI 79 MPI 138 MPI 138
System DFT: 5 mils]

[MPI INT 5.1R-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 79 MPI 139 MPI 139
System DFT: 5 mils]

[MPI INT 5.1R-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 141 MPI 141
System DFT: 5 mils]]

2. [Alkyd
[MPI INT 5.1E-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 79 MPI 49 MPI 49
System DFT: 5.25 mils]

[MPI INT 5.1E-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 79 MPI 51 MPI 51
System DFT: 5.25 mils]

[MPI INT 5.1E-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 47 MPI 47
System DFT: 5.25 mils]

[MPI INT 5.1E-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 48 MPI 48
System DFT: 5.25 mils]]

B. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. [Alkyd Floor Paint
MPI INT 5.1U-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 27 MPI 27 (plus NSA)
System DFT: 5.25 mils]

2. [Epoxy
MPI INT 5.1L-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 77 MPI 77 (plus NSA)
System DFT: 5.25 mils]

C. Metal in [toilets], [food-preparation], [food-serving], [restrooms], [laundry areas], [shower areas], [areas requiring a high degree of sanitation], [_____], [and other high-humidity areas] not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. [Alkyd
[MPI INT 5.1E-G3 (Eggshell)
Primer: Intermediate: Topcoat:

INTERIOR STEEL / FERROUS SURFACES
MPI 79 MPI 51 MPI 51
System DFT: 5.25 mils]

[MPI INT 5.1E-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 47 MPI 47
System DFT: 5.25 mils]

[MPI INT 5.1E-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 48 MPI 48
System DFT: 5.25 mils]]

2. [Alkyd
[MPI INT 5.1T-G3 (Eggshell) For hand tool cleaning
Primer: Intermediate: Topcoat:
MPI 23 MPI 51 MPI 51
System DFT: 5.25 mils]

[MPI INT 5.1T-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 23 MPI 47 MPI 47
System DFT: 5.25 mils]

[MPI INT 5.1T-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 23 MPI 48 MPI 48
System DFT: 5.25 mils]]

D. Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surfaces as follows: [_____]

1. [Aluminum Paint
MPI INT 5.1M
Primer: Intermediate: Topcoat:
MPI 79 MPI 1 MPI 1
System DFT: 4.25 mils]

E. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. [High Performance Architectural Latex
[MPI INT 5.4F-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 95 MPI 138 MPI 138
System DFT: 5 mils]

[MPI INT 5.4F-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 95 MPI 139 MPI 139
System DFT: 5 mils]

[MPI INT 5.4F-G4 (Satin)
Primer: Intermediate: Topcoat:
MPI 95 MPI 140 MPI 140
System DFT: 5 mils]

INTERIOR STEEL / FERROUS SURFACES

[MPI INT 5.4F-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 141 MPI 141
System DFT: 5 mils]]

2. [Alkyd
[MPI INT 5.4J-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 95 MPI 49 MPI 49
System DFT: 5 mils]

[MPI INT 5.4J-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 95 MPI 51 MPI 51
System DFT: 5 mils]

[MPI INT 5.4J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 47 MPI 47
System DFT: 5 mils]

[MPI INT 5.4J-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 95 MPI 48 MPI 48
System DFT: 5 mils]]

F. Hot metal surfaces [including smokestacks] subject to temperatures up to 400 degrees F:

1. [Heat Resistant Enamel
MPI INT 5.2A
Primer: Intermediate: Topcoat:
MPI 21 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer]

G. Ferrous metal subject to high temperature, up to 750 degrees F:

1. [Inorganic Zinc Rich Coating
MPI INT 5.2C
Primer: Intermediate: Topcoat:
MPI 19 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer]

2. [Heat Resistant Aluminum Paint
MPI INT 5.2B (Aluminum Finish)
Primer: Intermediate: Topcoat:
MPI 2 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer]

H. [New surfaces and] [Existing surfaces] made bare cleaning to SSPC SP 10/NACE No. 2
subject to temperatures up to 593 degrees C (1100 degrees F):

INTERIOR STEEL / FERROUS SURFACES

1. [High Heat Resistant Coating
MPI INT 5.2D
Primer: Intermediate: Topcoat:
MPI 22 Surface preparation and number of coats per manufacturer's instructions.
System DFT: Per Manufacturer]

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New [and Existing, uncoated] Wood and plywood not otherwise specified:

1. [High Performance Architectural Latex
[MPI INT 6.4S-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 39 MPI 139 MPI 139
System DFT: 4.5 mils]

[MPI INT 6.4S-G4 (Satin)
Primer: Intermediate: Topcoat:
MPI 39 MPI 140 MPI 140
System DFT: 4.5 mils]

[MPI INT 6.4S-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 39 MPI 141 MPI 141
System DFT: 4.5 mils]]

2. [Alkyd
[MPI INT 6.4B-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 45 MPI 51 MPI 51
System DFT: 4.5 mils]

[MPI INT 6.4B-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 45 MPI 47 MPI 47
System DFT: 4.5 mils]

[MPI INT 6.4B-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 45 MPI 48 MPI 48
System DFT: 4.5 mils]]

3. [Institutional Low Odor / Low VOC Latex
[New; MPI INT 6.3V-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 39 MPI 144 MPI 144
System DFT: 4 mils]

[New; MPI INT 6.3V-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 39 MPI 145 MPI 145
System DFT: 4 mils]

[New; MPI INT 6.3V-G4
Primer: Intermediate: Topcoat:

DIVISION 6: INTERIOR WOOD PAINT TABLE

MPI 39 MPI 146 MPI 146
System DFT: 4 mils]

[New; MPI INT 6.3V-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 39 MPI 147 MPI 147
System DFT: 4 mils]]

B. Existing, previously painted Wood and plywood not otherwise specified:

1. [High Performance Architectural Latex
[MPI RIN 6.4B-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 46 MPI 139 MPI 139
System DFT: 4.5 mils]

[MPI RIN 6.4B-G4 (Satin)
Primer: Intermediate: Topcoat:
MPI 46 MPI 140 MPI 140
System DFT: 4.5 mils]

[MPI RIN 6.4B-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 46 MPI 141 MPI 141
System DFT: 4.5 mils]]

2. [Alkyd
[MPI RIN 6.4C-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 46 MPI 51 MPI 51
System DFT: 4.5 mils]

[MPI RIN 6.4C-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 46 MPI 47 MPI 47
System DFT: 4.5 mils]

[MPI RIN 6.4C-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 46 MPI 48 MPI 48
System DFT: 4.5 mils]]

3. [Institutional Low Odor / Low VOC Latex
[Existing; MPI RIN 6.4D-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 39 MPI 144 MPI 144
System DFT: 4 mils]

[Existing; MPI RIN 6.4D-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 39 MPI 145 MPI 145
System DFT: 4 mils]

[Existing; MPI RIN 6.4D-G4
Primer: Intermediate: Topcoat:
MPI 39 MPI 146 MPI 146
System DFT: 4 mils]

DIVISION 6: INTERIOR WOOD PAINT TABLE
[Existing; MPI RIN 6.4D-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 39 MPI 147 MPI 147
System DFT: 4 mils]]

C. New [and Existing, previously finished or stained] Wood and Plywood, except floors; natural finish or stained:

1. [Natural finish, oil-modified polyurethane
[New; MPI INT 6.4J-G4 / Existing; MPI RIN 6.4L-G4
Primer: Intermediate: Topcoat:
MPI 57 MPI 57 MPI 57
System DFT: 4 mils]

[New; MPI INT 6.4J-G6 (Gloss) / Existing; MPI RIN 6.4L-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 56 MPI 56 MPI 56
System DFT: 4 mils]]

2. [Stained, oil-modified polyurethane
[New; MPI INT 6.4E-G4 / Existing; MPI RIN 6.4G-G4
Stain: Primer: Intermediate: Topcoat:
MPI 90 MPI 57 MPI 57 MPI 57
System DFT: 4 mils]

[New; MPI INT 6.4E-G6 (Gloss) / Existing; MPI RIN 6.4G-G6 (Gloss)
Stain: Primer: Intermediate: Topcoat:
MPI 90 MPI 56 MPI 56 MPI 56
System DFT: 4 mils]]

3. [Stained, Moisture Cured Urethane
[New; MPI INT 6.4V-G2 (Flat) / Existing; MPI RIN 6.4V-G2 (Flat)
Stain: Primer: Intermediate: Topcoat:
MPI 90 MPI 71 MPI 71 MPI 71
System DFT: 4 mils]

[New; MPI INT 6.4V-G6 (Gloss) / Existing; MPI RIN 6.4V-G6 (Gloss)
Stain: Primer: Intermediate: Topcoat:
MPI 90 MPI 31 MPI 31 MPI 31
System DFT: 4 mils]]

D. New [and Existing, previously finished or stained] Wood Floors; Natural finish or stained:

1. [Natural finish, oil-modified polyurethane
New; MPI INT 6.5C-G6 (Gloss) / Existing; MPI RIN 6.5C-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 56 MPI 56 MPI 56
System DFT: 4 mils]

2. [Natural finish, Moisture Cured Polyurethane
New; MPI INT 6.5K-G6 (Gloss) / Existing; MPI RIN 6.5D-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 31 MPI 31 MPI 31
System DFT: 4 mils]

3. [Stained, oil-modified polyurethane
New; MPI INT 6.5B-G6 (Gloss) / Existing; MPI RIN 6.5B-G6 (Gloss)

DIVISION 6: INTERIOR WOOD PAINT TABLE

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 56	MPI 56	MPI 56

System DFT: 4 mils]

4. [Stained, Moisture Cured Polyurethane
New; MPI INT 6.5J-G6 (Gloss) / Existing; MPI RIN 6.5L-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 31	MPI 31	MPI 31

System DFT: 4 mils]

E. New [and Existing, previously coated] Wood floors; pigmented finish:

1. [Latex Floor Paint
[New; MPI INT 6.5G-G2 (Flat) / Existing; MPI RIN 6.5J-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 60	MPI 60

System DFT: 4.5 mils]

[New; MPI INT 6.5G-G6 (Gloss) / Existing; MPI RIN 6.5J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 68	MPI 68

System DFT: 4.5 mils]]

2. [Alkyd Floor Paint
[New; MPI INT 6.5A-G2 (Flat) / Existing; MPI RIN 6.5A-G2 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 59	MPI 59	MPI 59

System DFT: 4.5 mils]

[New; MPI INT 6.5A-G6 (Gloss) / Existing; MPI RIN 6.5A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 27	MPI 27	MPI 27

System DFT: 4.5 mils]]

F. New [and Existing, uncoated] wood surfaces in [toilets], [food-preparation], [food-serving], [restrooms], [laundry areas], [shower areas], [areas requiring a high degree of sanitation], [_____] [and other high humidity areas] not otherwise specified.:

1. [As specified in Section 09 96 59 HIGH-BUILD GLAZE COATINGS.]

2. [Waterborne Light Industrial
[MPI INT 6.3P-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 153	MPI 153

System DFT: 4.5 mils]

[MPI INT 6.3P-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 154	MPI 154

System DFT: 4.5 mils]]

3. [Alkyd
[MPI INT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47

System DFT: 4.5 mils]

DIVISION 6: INTERIOR WOOD PAINT TABLE

[MPI INT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48

System DFT: 4.5 mils]]

G. Existing, previously painted wood surfaces in [toilets], [food-preparation], [food-serving], [restrooms], [laundry areas], [shower areas], [areas requiring a high degree of sanitation], [_____] [and other high humidity areas] not otherwise specified:

1. [As specified in Section 09 96 59 HIGH-BUILD GLAZE COATINGS.]

2. [Waterborne Light Industrial Coating

[MPI RIN 6.3P-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 153	MPI 153

System DFT: 4.5 mils]

[MPI RIN 6.3P-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 154	MPI 154

System DFT: 4.5 mils]]

3. [Alkyd

[MPI RIN 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 47	MPI 47

System DFT: 4.5 mils]

[MPI RIN 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 48	MPI 48

System DFT: 4.5 mils]]

H. New [and Existing, previously finished or stained] Wood Doors; Natural Finish or Stained:

1. [Natural finish, oil-modified polyurethane

[New; MPI INT 6.3K-G4 / Existing; MPI RIN 6.3K-G4

Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

System DFT: 4 mils]

[New; MPI INT 6.3K-G6 (Gloss) / Existing; MPI RIN 6.3K-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 56	MPI 56	MPI 56

System DFT: 4 mils]

Note: Sand between all coats per manufacturers recommendations.]

2. [Stained, oil-modified polyurethane

[New; MPI INT 6.3E-G4 / Existing; MPI RIN 6.3E-G4

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 57	MPI 57	MPI 57

System DFT: 4 mils]

[New; MPI INT 6.3E-G6 (Gloss) / Existing; MPI RIN 6.3E-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:

DIVISION 6: INTERIOR WOOD PAINT TABLE

MPI 90	MPI 56	MPI 56	MPI 56

System DFT: 4 mils]

Note: Sand between all coats per manufacturers recommendations.]

3. [Stained, Moisture Cured Urethane

[New; MPI INT 6.4V-G2 (Flat) / Existing; MPI RIN 6.4V-G2 (Flat)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 71	MPI 71	MPI 71

System DFT: 4 mils]

[New; MPI INT 6.4V-G6 (Gloss) / Existing; MPI RIN 6.4V-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 31	MPI 31	MPI 31

System DFT: 4 mils]

Note: Sand between all coats per manufacturers recommendations.]

I. New [and Existing, uncoated] Wood Doors; Pigmented finish:

1. [Alkyd

[New; MPI INT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47

System DFT: 4.5 mils]

[New; MPI INT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48

System DFT: 4.5 mils]

Note: Sand between all coats per manufacturers recommendations.]

2. [Pigmented Polyurethane

New; MPI INT 6.1E-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 72	MPI 72	MPI 72

System DFT: 4.5 mils

Note: Sand between all coats per manufacturers recommendations.]

J. Existing, previously painted Wood Doors; Pigmented finish:

1. [Alkyd

[New; MPI RIN 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 47	MPI 47

System DFT: 4.5 mils]

[New; MPI RIN 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 46	MPI 48	MPI 48

System DFT: 4.5 mils]

Note: Sand between all coats per manufacturers recommendations.]

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New [and Existing, previously painted] [Plaster] [and] [Wallboard] not otherwise specified:

1. [Latex
[New; MPI INT 9.2A-G2 (Flat) / Existing; RIN 9.2A-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 50 MPI 44 MPI 44
System DFT: 4 mils]

[New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 50 MPI 52 MPI 52
System DFT: 4 mils]

[New; MPI INT 9.2A-G5 (Semigloss) / Existing; RIN 9.2A-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 54 MPI 54
System DFT: 4 mils]]

2. [High Performance Architectural Latex - High Traffic Areas
[New; MPI INT 9.2B-G2 (Flat) / Existing; MPI RIN 9.2B-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 50 MPI 138 MPI 138
System DFT: 4 mils]

[New; MPI INT 9.2B-G3 (Eggshell) / Existing; MPI RIN 9.2B-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 50 MPI 139 MPI 139
System DFT: 4 mils]

[New; MPI INT 9.2B-G5 (Semigloss) / Existing; MPI RIN 9.2B-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 141 MPI 141
System DFT: 4 mils]]

3. [Institutional Low Odor / Low VOC Latex
[New; MPI INT 9.2M-G2 (Flat) / Existing; MPI RIN 9.2M-G2 (Flat)
Primer: Intermediate: Topcoat:
MPI 50 MPI 144 MPI 144
System DFT: 4 mils]

[New; MPI INT 9.2M-G3 (Eggshell) / Existing; MPI RIN 9.2M-G3 (Eggshell)
Primer: Intermediate: Topcoat:
MPI 50 MPI 145 MPI 145
System DFT: 4 mils]

[New; MPI INT 9.2M-G4 (Satin) / Existing; MPI RIN 9.2M-G4 (Satin)
Primer: Intermediate: Topcoat:
MPI 50 MPI 146 MPI 146
System DFT: 4 mils]

[New; MPI INT 9.2M-G5 (Semigloss) / Existing; MPI RIN 9.2M-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 50 MPI 147 MPI 147
System DFT: 4 mils]]

B. New [and Existing, previously painted] [Plaster] [and] [Wallboard] in

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE
[toilets], [food-preparation], [food-serving], [restrooms], [laundry areas], [shower areas], [areas requiring a high degree of sanitation], [_____] [and other high humidity areas] not otherwise specified.:

1. [Waterborne Light Industrial Coating
   New; MPI INT 9.2L-G5(Semigloss) / Existing; MPI RIN 9.2L-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 50 MPI 153 MPI 153
   System DFT: 4 mils]

2. [Alkyd
   New; MPI INT 9.2C-G5 (Semigloss) / Existing; MPI RIN 9.2C-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 50 MPI 47 MPI 47
   System DFT: 4 mils]

3. [Epoxy
   New; MPI INT 9.2E-G6 (Gloss) / Existing; MPI RIN 9.2D-G6 (Gloss)
   Primer: Intermediate: Topcoat:
   MPI 50 MPI 77 MPI 77
   System DFT: 4 mils]

-- End of Section --

SECTION 10 21 13

TOILET COMPARTMENTS
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.

ALUMINUM ASSOCIATION (AA)

AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A336/A336M	(2010a) Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A385/A385M	(2011) Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B221	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B36/B36M	(2013) Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B456	(2011; E 2011) Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
ASTM B86	(2013) Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings

ASTM D6386	(2010) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM D7611/D7611M	(2013) Standard Practice for Coding Plastic Manufactured Articles for Resin Identification
ASTM E2129	(2010) Standard Practice for Data Collection for Sustainability Assessment of Building Products

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2009) Accessible and Usable Buildings and Facilities

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS2460	(2013; Rev A) Plating, Chromium

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003	(Basic) Partitions, Toilet, Complete

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED NC	(2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System

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

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

1.2 SYSTEM DESCRIPTION

Provide a complete and usable toilet partition system, including toilet enclosures, room entrance screens, urinal screens, system of panels, hardware, and support components. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS and Affirmative Procurement guidelines. Furnish the partition system from a single manufacturer, with a standard product as shown in the most recent catalog data. Submit Fabrication Drawings for metal toilet partitions and urinal screens consisting of fabrication and assembly details to be performed in the factory. Submit manufacturer's Cleaning and Maintenance Instructions with Fabrication Drawings for review.

1.2.1 Sustainable Design Requirements

1.2.1.1 Local/Regional Materials Documentation

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials

to total dollar value of products included in project.

1.2.1.2 Environmental Data

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.[Submit Table 1 of ASTM E2129 for the following products: [_____].]

1.2.2 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D7611/D7611M. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.

Type 1	Polyethylene Terephthalate (PET, PETE)
Type 2	High Density Polyethylene (HDPE)
Type 3	Vinyl (Polyvinyl Chloride or PVC)
Type 4	Low Density Polyethylene (LDPE)
Type 5	Polypropylene (PP)
Type 6	Polystyrene (PS)
Type 7	Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

1.3 SUSTAINABILITY REQUIREMENTS

Materials in this technical specification may contribute towards contract compliance with sustainability requirements.

1.3.1 LEED REQUIREMENTS

See Section 01 33 29 LEED DOCUMENTATION for project LEED NC [local/regional materials,] [low-emitting materials,] [recycled content,] [certified wood][____] [and][rapidly renewable materials] requirements.

1.3.2 EPA Comprehensive Procurement Guidelines

See Section 01 62 35 RECYCLED/RECOVERED/BIOBASED MATERIALS for requirements associated with EPA designated products.

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.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00

SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings
Installation Drawings[; G][; G, [_____]]

SD-03 Product Data

Cleaning and Maintenance Instructions
Colors And Finishes
Galvanized Steel Sheet
Sound-Deadening Cores
Anchoring Devices and Fasteners
Hardware and Fittings
Brackets
Door Hardware
[Local/Regional Materials Documentation; (LEED NC)]
[Environmental Data]
Toilet Enclosures; (LEED NC)
Room Entrance Screens; (LEED NC)
Urinal Screens; (LEED NC)
Pilaster Shoes; (LEED NC)

SD-04 Samples

Colors and Finishes[; G][; G, [_____]]
Hardware and Fittings
Anchoring Devices and Fasteners

SD-07 Certificates

Warranty

SD-10 Operation and Maintenance Data

Plastic Identification

SD-11 Closeout Submittals

LEED Documentation
Local/Regional Materials Documentation; (LEED)
Toilet Enclosures; (LEED)
Room Entrance Screens; (LEED)
Urinal Screens; (LEED)
" Pilaster Shoes; (LEED)

1.5 REGULATORY REQUIREMENTS

Conform to ICC A117.1 code for access for the handicapped operation of toilet compartment door and hardware.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

1.7 WARRANTY

Provide certification or warranties that metal toilet partitions will be free of defects in materials, fabrication, finish, and installation and will remain so for a period of not less than [_____] years after completion.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheet

Provide galvanized steel sheet cold-rolled, stretcher-level, commercial quality material, conforming to ASTM A653/A653M. Conform surface preparation of material for painting to ASTM D6386, Method A.

2.1.2 Sound-Deadening Cores

Provide sound deadening consisting of treated kraft paper honeycomb cores with a cell size of not more than 1 inch. Resin-material content shall weigh not less than 11 percent of the finished core weight. Expanded cores shall be faced on both sides with kraft paper.

2.1.3 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

2.1.4 Brackets

Wall brackets shall be two-ear panel brackets, T-style, 1-inch stock. Provide stirrup style panel-to-pilaster brackets.

2.1.5 Hardware and Fittings

2.1.5.1 General Requirements

Conform hardware for the toilet partition system to CID A-A-60003 for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply latching devices and hinges for handicap compartments with 36 CFR 1191; provide [chrome-plated steel] [or] [stainless steel] devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

Material	Conformance Standard
Cold-rolled sheet steel	ASTM A336/A336M, commercial quality
Zinc-base alloy	ASTM B86, Alloy AC41-A
Brass	ASTM B36/B36M, Alloy C26800

Aluminum	ASTM B221
Corrosion-resistant steel	ASTM A167, Type [302][304]

2.1.5.2 Finishes

[a. Chrome plating shall conform to ASTM B456.]

[b. Finish shall conform to SAE AMS2460, Class I, Type [I][II].]

[c. Aluminum shall have a clear anodic coating conforming to AA DAF45.]

[d. Corrosion-resistant steel shall have a No. 4 finish.]

[e. Exposed fasteners shall match the hardware and fittings.]

2.1.6 Door Hardware

2.1.6.1 Hinges

Hinges shall be adjustable to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors to 10 degrees. Provide self-lubricating hinges with the indicated swing. Hinges shall [be the surface-mounted type.] [be the cutout-insert type.] [have the following type of return movement:

[a. Gravity return movement]

[b. Spring-action cam return movement]

[c. Torsion-rod return movement]]

2.1.6.2 Latch and Pull

Latch and pull shall be a combination rubber-faced door strike and keeper equipped with emergency access.

2.1.6.3 Coat Hooks

Coat hooks shall be combination units with hooks and rubber tipped pins.

2.2 PARTITION PANELS AND DOORS

Fabricate partition panels and doors not less than 1 inch thick with face sheets not less than 0.0396 inch thick.

2.2.1 Toilet Enclosures

Conform toilet enclosures to CID A-A-60003, Type I, Style [A, floor supported] [B, ceiling hung] [C, overhead braced] [F, overhead braced-alcove]. Furnish width, length, and height of toilet enclosures as shown. [Provide a width of 1 inch.] Finish surface of panels shall be [painted metal, Finish 1] [laminated plastic, Finish 3] [solid phenolic, Finish 4] [solid polyethylene, Finish 5] [_____]; water resistant; graffiti resistant; non-absorbent; [with plastic face sheets permanently fused to plastic core; 1/4 inch radius beveled edges]. [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content

requirements.] Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings.

2.2.2 Room Entrance Screens

Conform room entrance screens to CID A-A-60003, Type II, Style [A, floor anchored] [B, ceiling hung braced] [C, overhead braced] [D, wall hung] [_____]. Finish surface of screens shall be [painted metal, Finish 1] [laminated plastic, Finish 3] [solid phenolic, Finish 4] [solid polyethylene, Finish 5] [_____]; water resistant; graffiti resistant; non-absorbent[; with plastic face sheets permanently fused to plastic core; 1/4 inch radius beveled edges].[See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements.] Furnish length and height of screens as shown. [Provide thickness of 1 inch.] Fabricate screens from the same types of panels, pilasters, and fittings as the toilet partitions.

2.2.3 Urinal Screens

Conform urinal screens to CID A-A-60003, Type III, Style [A, floor supported] [B, ceiling hung] [C, overhead braced] [D, floor to ceiling hung] [E, floor to ceiling post supported]. Provide finish for surface of screens as [painted metal, Finish 1] [laminated plastic, Finish 3] [solid phenolic, Finish 4] [solid polyethylene, Finish 5] [_____]; water resistant; graffiti resistant; non-absorbent; [with plastic face sheets permanently fused to plastic core; 1/4 inch radius beveled edges]. [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements. This item may contain post-consumer or post-industrial recycled content]. Furnish width and height of urinal screens as shown. [Provide thickness of 1 inch.] Secure wall hung urinal screens with [a minimum of three wall stirrup brackets.] [42 inch long, continuous flanges.] Fabricate screens from the same types of panels and pilasters as the toilet partitions. Use corrosion-resistant steel fittings and fasteners.

2.3 CEILING-HUNG PARTITIONS

Pilasters shall be not less than 1-1/4 inch thick with face sheets not less than 0.0635 inch thick. Anchoring device at the top of the pilaster shall be welded to the reinforced face sheets and shall have not less than two 3/8 inch round threaded rods, lock washers, and leveling-adjustment nuts. Anchoring device shall be designed to transmit the strain and loading on the pilaster directly to the structural support above without putting strain or loading on the finished ceiling. Trim piece at the top of the pilaster shall be 3 inch high and fabricated from not less than 0.030 inch thick stainless steel.

2.4 FLOOR-ANCHORED PARTITIONS

Pilasters shall be not less than 1-1/4 inch thick with face sheets not less than 0.0635 inch thick. Provide anchoring device at the bottom of the pilaster consisting of a steel bar not less than 1/2 by 7/8 inch welded to the reinforced face sheets and having not less than two 3/8 inch round anchorage devices for securing to the floor slab. Provide anchorage devices complete with threaded rods, expansion shields, lock washers, and leveling-adjustment nuts. Trim piece at the floor shall be 3 inch high and fabricated from not less than 0.030 inch thick corrosion-resistant steel.

2.5 OVERHEAD-BRACED PARTITIONS

Pilasters shall be not less than 1-1/4 inch thick with face sheets not less than 0.0393 inch thick. Provide anchoring device at the bottom of the pilaster consisting of a channel-shaped floor stirrup fabricated from not less than 0.0635 inch thick material and a leveling bolt. Secure the stirrup to the pilaster with not less than a 3/16 inch bolt and nut after the pilaster is leveled. Secure the stirrup to the floor with not less than two lead expansion shields and sheetmetal screws. Fabricate overhead brace from a continuous extruded aluminum tube not less than 1 inch wide by 1-1/2 inch high, 0.125-inch wall thickness. Finish shall be AA-C22A31 in accordance with AA DAF45. Set and secure brace into the top of each pilaster. Fabricate 3 inch high trim piece at the floor from not less than 0.030 inch thick corrosion-resistant steel.

2.6 PILASTER SHOES

Provide shoes at pilasters to conceal floor-mounted anchorage. Pilaster shoes shall be [aluminum] [stainless steel] [one piece molded HDPE] [_____]. [See Section 01 33 29 LEED(tm) DOCUMENTATION for cumulative total recycled content requirements.] Height shall be 3 inches.

2.7 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. [Hardware shall be pre-drilled by manufacturer.] Hardware finish shall be highly resistant to alkalis, urine, and other common toilet room acids. [Hardware shall include: chrome plated non ferrous cast pivot hinges, gravity type, adjustable for door close positioning; nylon bearings; black anodized aluminum door latch; door strike and keeper with rubber bumper; and cast alloy chrome plated coat hook and bumper, [_____].] Latching devices and hinges for handicap compartments shall comply with 36 CFR 1191 and shall be [chrome-plated steel] [or] [stainless steel] door latches that operate without either tight grasping or twisting of the wrist of the operator. [Screws and bolts shall be stainless steel, tamper proof type. Wall mounting brackets shall be continuous, full height, [aluminum] [stainless steel] [heavy duty plastic] [_____], in accordance with toilet compartment manufacturer's instructions. Floor-mounted anchorage shall consist of corrosion-resistant anchoring assemblies with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor.]

2.8 COLORS AND FINISHES

2.8.1 Colors

Provide manufacturer's standard color charts for color of finishes for toilet partition system components. [Color of pilaster shoes shall match the core of solid plastic compartments and screens.] Submit three samples showing a finished edge on two adjacent sides and core construction, each not less than 12-inch square

2.8.2 Finishes No. 1 Through No. 3

Conform partitions, panels, screen, and door finishes to CID A-A-60003 finished with [Finish No. 1, baked enamel] [Finish No. 2, stainless steel] [Finish No. 3, laminated plastic].

2.8.3 Finishes No.4 and No. 5

Provide solid plastic fabricated of [solid phenolic core with melamine facing sheets] [or] [polymer resins (polyethylene)] formed under high pressure rendering a single component section not less than one inch thick. Colors shall extend throughout the panel thickness. Provide exposed finish surfaces: smooth, waterproof, non-absorbent, and resistant to staining and marking with pens, pencils, or other writing devices. Solid plastic partitions shall not show any sign of deterioration when immersed in the following chemicals and maintained at a temperature of 80 degrees F for a minimum of 30 days:

Acetic Acid (80 percent)	Hydrochloric Acid (40 percent)
Acetone	Hydrogen Peroxide (30 percent)
Ammonia (liquid)	Isopropyl Alcohol
Ammonia Phosphate	Lactic Acid (25 percent)
Bleach (12 percent)	Lime Sulfur
Borax	Nicotine
Brine	Potassium Bromide
Caustic Soda	Soaps
Chlorine Water	Sodium Bicarbonate
Citric Acid	Trisodium Phosphate
Copper Chloride	Urea; Urine
Core Oils	Vinegar

PART 3 EXECUTION

3.1 PREPARATION

Take field measurements prior to the preparation of drawing and fabrication to ensure proper fits. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work. Verify correct spacing of plumbing fixtures. Verify correct location of built in framing, anchorage, and bracing. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 METAL PARTITION FABRICATION

a. Fabricate metal Partition Panels, doors, screens, and pilasters required for the project from galvanized-steel face sheets with formed edges. Face sheets shall be pressure-laminated to the sound-deadening core with edges sealed with a continuous locking strip and corners mitered and welded. Ground all welds smooth. Provide concealed reinforcement for installation of hardware, fittings, and accessories.

Surface of face sheets shall be smooth and free from wave, warp, or buckle.

b. Before application of an enamel coating system, solvent-clean galvanized-steel surfaces to remove processing compounds, oils, and other contaminants harmful to coating-system adhesion. After cleaning,coat the surfaces with a metal-pretreatment phosphate coating. After pretreatment, finish exposed galvanized-steel surfaces with a baked-enamel coating system as specified.

c. Provide an enamel coating system consisting of a factory-applied baked acrylic enamel coating system. Coating system shall be a durable, washable, stain-resistant, mar-resistant finish.

3.3 INSTALLATION

Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than 1/2 inch and secure the panels to walls and pilasters with not less than two wall brackets attached near the top and bottom of the panel. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure Panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door with hinges, one door latch, and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors.

a. Secure panels to hollow plastered walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts shall have a load-carrying strength of not less than 600 pounds per anchor.

b. Secure panels to ceramic tile on hollow plastered walls or hollow concrete-masonry walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts shall have a load-carrying strength of not less than 600 pounds per anchor.

c. Secure panels to solid masonry or concrete with lead or brass expansion shields designed for use with not less than 1/4-20 screws, with a shield length of not less than 1-1/2 inch. Expansion shields shall have a load-carrying strength of not less than 600 pounds per anchor.

d. Submit Installation Drawings for metal toilet partitions and urinal screens showing plans, elevations, details of construction, hardware, reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

3.4 CEILING-HUNG PARTITIONS

Secure pilasters to the structural support above with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level the bottoms of doors with bottoms of pilasters when doors are in a closed position.

3.5 FLOOR-ANCHORED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level tops of doors with tops of pilasters when doors are in a closed position. Expansion shields shall have a minimum 2-inch penetration into the concrete slab.

3.6 OVERHEAD-BRACED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Secure overhead brace to the pilaster face with not less than two fasteners per face. Expansion shields shall have a minimum 2-inch penetration into the concrete slab. Make tops of doors parallel with the overhead brace when doors are in a closed position.

3.7 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched.

3.8 CLEANING

Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Clean all surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

-- End of Section --

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	(2012; Amendment 1 2012) 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 505	(2013) Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations
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 154	(2005; Reprint May 2014) Carbon-Dioxide Fire Extinguishers
UL 2129	(2005; Reprint Mar 2012) Halocarbon Clean Agent Fire Extinguishers

UL 299	(2012) Dry Chemical Fire Extinguishers
UL 626	(2005; Reprint Mar 2012) 2-1/2 Gallon Stored-Pressure, Water-Type Fire Extinguishers
UL 8	(2005; Reprint Jun 2011) Water Based Agent 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.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REQUIREMENTS. 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

Cabinets

Wall Brackets

SD-03 Product Data

Fire Extinguishers

Accessories

Cabinets

Wall Brackets

Replacement Parts

SD-04 Samples

Fire Extinguisher

Cabinet

Wall Brackets

Accessories

SD-07 Certificates

Fire Extinguishers

Manufacturer's Warranty with Inspection Tag

1.3 DELIVERABLES

1.3.1 Samples

Provide the following samples: One of each type of Fire Extinguisher being installed; one full-sized sample of each type of Cabinet being installed; three samples of Wall Brackets and Accessories of each type being used.

Approved samples may be used for installation, with proper identification and storage.

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.

[Provide portable fire extinguishers in compliance with NFPA 505 for all ancillary vehicles where Fire Safety Standard for Powered Industrial Trucks, including type designations, special c conditions relating to areas of use, conversions, maintenance, or specific operations apply.

]1.5 WARRANTY

Guarantee that Fire Extinguishers are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than [_____] years after completion.

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, Cabinets, 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 [stored-pressure] [cartridge] [hand-pump] water type fire extinguishers.

][Provide [foam] type fire extinguishers.

][Provide carbon-dioxide type fire extinguishers compliant with UL 154.

][Provide dry chemical type fire extinguishers compliant with UL 299.

][Provide wet chemical type fire extinguishers compliant with UL 8.

][Provide clean agent type fire extinguishers compliant with UL 2129.

][Provide dry powder type fire extinguishers.

][Provide water mist type fire extinguishers compliant with UL 626.

] Submit Manufacturer's Data for each type of Fire Extinguisher required, detailing all related Cabinet, Wall Mounting and Accessories information, complete with Manufacturer's Warranty with Inspection Tag.

2.2 MATERIAL

Provide [corrosion-resistant steel] [aluminum] [enameled steel] [_____] extinguisher shell.

2.3 SIZE

[2-1/2 gallons extinguishers.

][2-1/2 pounds extinguishers.

][[5] [10] [15] [20] [30] pounds extinguishers.

]2.4 ACCESSORIES

[Forged brass valve

][Fusible plug

][Safety release

][Antifreeze

][Pressure gage

]2.5 CABINETS

2.5.1 Material

Provide [enameled steel] [corrosion-resistant steel] [aluminum] cabinets.

2.5.2 Type

[Provide [recessed] [trimless] [surface] type cabinets.

] [Provide semi-recessed cabinet for a [6-inch] [4-inch] wall.

][Provide [recessed] [trimless] [surface] bubble type cabinets.

]2.5.3 Size

Dimension cabinets to accommodate the specified fire extinguishers.

2.6 WALL BRACKETS

Provide[running-board][spring-clip][wall-hook] 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 --

SECTION 10 51 13

METAL LOCKERS
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 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 A568/A568M	(2013a) Standard Specifications for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2013) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B456	(2011; E 2011) Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
ASTM D6386	(2010) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-22750	(2011; Rev G) Coating, Epoxy, High Solids
MIL-PRF-23377	(2012; Rev K) Primer Coatings: Epoxy, High Solids

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-L-00486	(Rev J) Lockers, Clothing, Steel

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Types[; G][; G, [_____]]

Location[; G][; G, [_____]]

Installation

[Numbering system]

SD-03 Product Data

Material

Locking Devices

[Lock Control Chart]

Handles

Finish

Locker components

Assembly instructions

SD-04 Samples

Color chips[; G][; G, [_____]]

1.3 DELIVERY, HANDLING, AND STORAGE

Deliver lockers and associated materials in their original packages, containers, or bundles bearing the manufacturer's name and the name of the material. Protect from weather, soil, and damage during delivery, storage, and construction.

1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication. Verify correct location

1.5 QUALITY ASSURANCE

1.5.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color [scheduled] [indicated].

Government may request performance-characteristic tests on assembled lockers. Tests and results must conform to FS AA-L-00486. Lockers not conforming will be rejected.

PART 2 PRODUCTS

2.1 TYPES

Locker must have the following type and size in the location and quantities indicated. Locker finish colors will be as scheduled.

2.1.1 Single-tier Lockers

Single-tier lockers must be as follows:

[Type STL-1: Single-tier locker 15 inches wide, 15 inches deep, and 72 inches high, attached to 6-inch high legs]

[Type STL-2: Single-tier locker 15 inches wide, 18 inches deep, and 72 inches high, attached to 6-inch high legs]

[Type STL-3: Single-tier locker 18 inches wide, 21 inches deep, and 72 inches high, attached to 6-inch high legs]

[Type STL-4: Single-tier locker 18 inches wide, 24 inches deep, and 72 inches high, attached to 6-inch high legs]

[Type STC-1: Single-tier locker 15 inches wide, 15 inches deep, and 72 inches high, attached to 6-inch closed base]

[Type STC-2: Single-tier locker 15 inches wide, 18 inches deep, and 72 inches high, attached to 6-inch high closed base]

[Type STC-3: Single-tier locker 18 inches wide, 21 inches deep, and 72 inches high, attached to 6-inch high closed base]

[Type STC-4: Single-tier locker 18 inches wide, 24 inches deep, and 72 inches high, attached to 6-inch high closed base]

[Type STW-2: Single-tier locker 15 inches wide, 18 inches deep, and 72 inches high, without base]

[Type STW-3: Single-tier locker 18 inches wide, 21 inches deep, and 72 inches high, without base]

[Type STW-4: Single-tier locker 18 inches wide, 24 inches deep, and 72 inches high, without base]

2.1.2 Double-Tier

Double-tier lockers must be as follows:

Type DTL-1: Double-tier locker 15 inches wide, 15 inches deep, and 72 inches high, attached to 6-inch high legs

Type DTL-2: Double-tier locker 15 inches wide, 18 inches deep, and 72 inches high, attached to 6-inch high legs

Type DTC-1: Double-tier locker 15 inches wide, 15 inches deep, and 72 inches high, attached to a 6-inch high closed base

Type DTC-2: Double-tier locker 15 inches wide, 18 inches deep, and 72 inches high, attached to a 6-inch high closed base

Type DTW-1: Double-tier locker 15 inches wide, 15 inches deep, and 72 inches high, without base

Type DTW-2: Double-tier locker 15 inches wide, 18 inches deep, and 72 inches high, without base

2.2 MATERIAL

2.2.1 [Galvanized] Steel Sheet

[[ASTM A1008/A1008M] [ASTM A568/A568M], commercial quality, minimized spangle material. Prepare material surfaces for [baked enamel] [_____] finishing in accordance with FS AA-L-00486.[Fabricate locker bodies from not less than 0.0239-inch thick steel sheet.][Minimum uncoated sheet thickness [as specified] [_____].]]

[ASTM A653/A653M and ASTM A924/A924M, commercial quality, minimized spangle, galvanized steel sheet with not less than G60 zinc coating. Prepare surface of sheet for painting in accordance with ASTM D6386, Method A. Minimum uncoated sheet thickness [as specified] [_____].]

2.2.2 Chromium Coating

Nickel and chromium electrodeposited on the specified base metal. Conform to ASTM B456, SC-3, as applicable to the base metal.

2.2.3 Finish

[FS AA-L-00486.]

[Primer, [MIL-PRF-23377] [_____]; topcoat, [MIL-PRF-22750] [_____].]

2.2.3.1 Color

As selected.

2.3 COMPONENTS

2.3.1 Built-In Locks

[FS AA-L-00486. Provide locking devices as [built-in key locks] [built-in combination locks] [and] [a padlock eye in the door latching mechanism].][Submit Lock Control Chart showing each lock required for the project, the locker identification plate number, and the lock combination.]

[Built-in locks are not required.]

2.3.2 Coat Hooks

FS AA-L-00486, [chromium] [zinc] plated.

2.3.3 [Hanger Rods

FS AA-L-00486.

]2.3.4 Door Handles

FS AA-L-00486. [Provide zinc alloy or steel handles with a chromium coating.]

2.3.5 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

2.3.5.1 Hinges

In addition to the requirements of FS AA-L-00486, provide 5-knuckle hinges, minimum 2 inches high. Fabricate knuckle hinges from not less than 0.0787 inch thick steel sheet. [A full height piano hinge may be provided if standard with the manufacturer.] Weld or bolt hinges to the door frame. Weld, bolt, or rivet hinges to the door.

2.3.5.2 Latching Mechanisms

FS AA-L-00486.

2.3.6 Latch Strikes

FS AA-L-00486. Fabricate from not less than 0.0787 inch thick steel sheet, except latch strike may be continuous from top to bottom and fabricated as part of the door framing.

2.3.7 Silencers

FS AA-L-00486.

2.3.8 Back and Side Panels, Tops, and Bottoms

FS AA-L-00486, not less than 0.0474 inch thick steel sheet.

[2.3.9 Sloping Locker Tops

Provide sloping locker tops in addition to the locker-section flat tops. Sloping tops must be continuous in length. Provide fillers or closures at the exposed end of sloping tops. Fabricate sloping tops from not less than 0.0478-inch thick steel sheet.

]2.3.10 Shelves

FS AA-L-00486. Fabricate from not less than 0.0598 inch thick steel sheet.

2.3.11 [Base Panels

FS AA-L-00486.

]2.3.12 Legs

[FS AA-L-00486.] [Provide lockers without legs, as indicated.]

2.3.13 Number Plates

[FS AA-L-00486. [Aluminum] [Brass] [Zinc]. Provide consecutive numbers from [_____] to [_____].]

[Number plates are not required.]

2.3.14 [Label Holders

FS AA-L-00486.

]2.3.15 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Secure lockers to wall [and base] with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

3.2 [NUMBERING SYSTEM

Install number plates on lockers consecutively [with odd numbers on top and even numbers on bottom] [as indicated] [_____].

]3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.3 Cleaning

Clean surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner. Remove equipment, surplus materials, and rubbish from the site.

-- End of Section --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
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.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010	(2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4	(1999; Addenda A 2000, Addenda B 2001; R 2014) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2010; ERTA 2011-2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2008) Performance Requirements for Atmospheric Type Vacuum Breakers (ANSI approved 2009)
ASSE 1003	(2009) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)

ASSE 1018	(2001) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002
ASSE 1019	(2011) Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type (ANSI Approved 2004)
ASSE 1020	(2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B301	(2010) Liquid Chlorine
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(2011) Grooved and Shouldered Joints
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C652	(2011) Disinfection of Water-Storage Facilities
AWWA C700	(2009) Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(2012) Standard for Cold-Water Meters - Turbine Type for Customer Service

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding
AWS B2.2/B2.2M	(2010) Specification for Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(2012) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
ASME A112.19.2/CSA B45.1	(2013) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.36.2M	(1991; R 2012) Cleanouts
ASME A112.6.1M	(1997; R 2012) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public

	Use
ASME A112.6.3	(2001; R 2007) Standard for Floor and Trench Drains
ASME A13.1	(2007; R 2013) Scheme for the Identification of Piping Systems
ASME B1.20.1	(2013) Pipe Threads, General Purpose (Inch)
ASME B16.18	(2012) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2011) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2013) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2009) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.50	(2013) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASME B31.1	(2014; INT 1-47) Power Piping
ASME B31.5	(2013) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2010) BPVC Section IV-Rules for Construction of Heating Boilers
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 A105/A105M	(2014) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A193/A193M	(2014) Standard Specification for Alloy-Steel and Stainless Steel Bolting

	Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A733	(2003; E 2009; R 2009) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM B370	(2012) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B42	(2010) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B584	(2014) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B813	(2010) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B88	(2014) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2013) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C564	(2014) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D2564	(2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2665	(2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2822/D2822M	(2005; E 2011; R 2011) Asphalt Roof Cement

ASTM D2855	(1996; R 2010) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3139	(1998; R 2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3311	(2011) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F1760	(2001; R 2011) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F477	(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F891	(2010) Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(2010) Copper Tube Handbook

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2009) Accessible and Usable Buildings and Facilities
ICC IPC	(2012) International Plumbing Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1	(2009) American National Standard for Emergency Eyewash and Shower Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(2013) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993; Reaffirmed 2010) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and

	Installation
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2013) Bronze Gate, Globe, Angle and Check Valves

NACE INTERNATIONAL (NACE)

NACE SP0169	(2013) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2011; Errata 2012) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2015) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF/ANSI 61	(2014) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man	(2010) Firestopping: Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(2010) Water Hammer Arresters Standard

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223	(2004) Enzyme Substrate Coliform Test
PL 93-523	(1974; A 1999) Safe Drinking Water Act

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

10 CFR 430	Energy Conservation Program for Consumer Products
40 CFR 141.80	National Primary Drinking Water Regulations; Control of Lead and Copper; General Requirements

PL 109-58 Energy Policy Act of 2005 (EPAct05)

UNDERWRITERS LABORATORIES (UL)

UL 174 (2004; Reprint Sep 2012) Household Electric Storage Tank Water Heaters

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

Plumbing System; G

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush valve water closets

Flush valve urinals

Countertop lavatories

Mop sinks

Drinking-water coolers; G

Water heaters; G

Pumps; G

Backflow prevention assemblies; G

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; G

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System; G

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size.

The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

1.5.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE) .

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC. Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - IP

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 Materials

Materials for various services shall be in accordance with TABLES I and II. Steel pipe shall contain a minimum of 25 percent recycled content, with a minimum of 16 percent post-consumer recycled content. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in building.

2.1.1 Pipe Joint Materials

Solder containing lead shall not be used with copper pipe. Joints and gasket materials shall conform to the following:

a. Coupling for Steel Pipe: AWWA C606.

b. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

c. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

d. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

e. Solder Material: Solder metal shall conform to ASTM B32.

f. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

g. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

h. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.

i. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.

j. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc.,

shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.

k. Copper tubing shall conform to ASTM B88, Type K or L.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be piston type.

b. Copper, Sheet and Strip for Building Construction: ASTM B370.

c. Asphalt Roof Cement: ASTM D2822/D2822M.

d. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

e. Metallic Cleanouts: ASME A112.36.2M.

f. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

g. Liquid Chlorine: AWWA B301.

h. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

i. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard

Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4

2.3.1 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.2 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.3 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a

relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.4 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat.

Water flushing volume of the water closet and flush valve combination shall not exceed1.28 gallons per flush.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush

valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls.

2.4.2 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.125 gallons per flush. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture.

2.4.3 Countertop Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, self-rimming, minimum dimensions of 19 inches wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide aerator with faucet. Water flow rate shall not exceed 0.5 gpm when measured at a flowing water pressure of 60 psi. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor. Provide top mounted washerless centerset lavatory faucets.

2.4.4 Wheelchair Drinking Water coolers

AHRI 1010, wall-mounted split-level, bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27 inch minimum knee clearance from front bottom of unit to floor and 36 inch maximum spout height above floor. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet. Provide filters for chlorine in supply piping to faucets.

2.4.5 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.4.6 Emergency Eyewash and Shower

ANSI/ISEA Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

2.5 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the

Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

2.7 TRAPS

Unless otherwise specified, traps shall be copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be withouta cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume shall be as indicated.

2.8.1 Automatic Storage Type

2.8.1.1 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time.

2.9 PUMPS

2.9.1 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor shall be supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover.

Integral size motors shall be premium efficiency type in accordance with NEMA MG 1. Pump motors smaller than 1 hp Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

2.9.2 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.10 COMPRESSED AIR SYSTEM

2.10.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including 1 phase, 460 volt motor controls, switches, wiring, accessories, and motor controllers, in a NEMA 250, Type 4 enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each compressor shall start and stop automatically at upper and lower pressure limits of the system, regulate pressure by constant speed compressor loading and unloading, and have a manual-off-automatic switch that when in the manual position, the compressor loads and unloads to meet the demand and, in the automatic position, a time delay relay shall allow the compressor to operate for an adjustable length of time unloaded, then stop the unit. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with automatic alternation system. Each compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensate before the air enters the receiver. Aftercoolers shall be either air-cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve, which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.10.2 Air Receivers

Receivers shall be designed for 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPVC SEC VIII D1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

2.10.3 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 125 psi, capacity as indicated.

2.10.4 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 125 psi and a maximum temperature of 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded

connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 125 psi. Regulator shall be sized as indicated.

2.11 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, indicating gallons as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

2.12 MISCELLANEOUS PIPING ITEMS

2.12.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.12.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.12.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.12.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.12.3 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.12.4 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal

block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A full port ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 125 psig working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.3.3 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, ASME B16.50, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

3.1.3.4 Plastic Pipe

PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3.5 Other Joint Methods

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric

waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe shall be in accordance with Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE) . Coatings shall be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.6.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside

of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.6.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing

guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.6.4 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.6.5 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads.

3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.8.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.9 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames,

anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

3.2.3 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.4 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided.

Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lurinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.4.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.

3.3.7 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer. Compressors shall be mounted to resist seismic loads.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping shall be in accordance with ASME A13.1.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or

split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.8.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.8.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to

temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a

period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.9.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take addition samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA SM 9223. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.10 WASTE MANAGEMENT

Place materials defined as hazardous or toxic waste in designated containers. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place used sealant and adhesive tubes and containers in areas designated for hazardous waste. Separate copper and ferrous pipe waste in accordance with the Waste Management Plan and place in designated areas for reuse.

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.12.1 Storage Water Heaters

3.12.1.1 Electric

a. Storage capacity of 60 gallons shall have a minimum energy factor (EF) of 0.93 or higher per FEMP requirements.

b. Storage capacity of 60 gallons or more shall have a minimum energy factor (EF) of 0.91 or higher per FEMP requirements.

3.13 TABLES

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760	X	X	X	X	X	X

SERVICE:
A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
* - Hard Temper

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
1	Malleable-iron threaded fittings:				
	a. Galvanized, ASME B16.3	X	X	X	X
	b. Same as "a" but not galvanized			X	
7	Seamless copper pipe, ASTM B42	X	X		X

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
8	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**	X**	X***
10	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22	X	X	X	X
11	Cast copper alloy solder-joint pressure fittings, ASME B16.18	X	X	X	X
12	Bronze and sand castings groovedjoint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 2	X	X	X	
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		
36	Nipples, pipe threaded ASTM A733	X	X	X	
38	Press Fittings: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Gas D - Cold Water Service Belowground Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints				

TABLE III

STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
A. STORAGE WATER HEATERS				
Elect. Heat Pump		24 Amps or less and 250 Volts or less	10 CFR 430	EF = 0.93-0.00132V

TERMS:

EF = Energy factor, minimum overall efficiency.
ET = Minimum thermal efficiency with 70 degrees F delta T.
SL = Standby loss is maximum Btu/h based on a 70 degree F temperature difference between stored water and ambient requirements.
V = Rated storage volume in gallons
Q = Nameplate input rate in Btu/h

-- End of Section --

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	(2012) Laboratory Methods of Testing Dampers for Rating

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(2014) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; ERTA 2012; S 2013) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	(2012; Errata 2013; INT 1 2014) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	(2010; Errata 2011; INT 3 2012; INT 4 2012; INT 5 2013) Ventilation for Acceptable Indoor Air Quality
ASHRAE 70	(2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 90.1 - IP	(2010; ERTA 2011-2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A924/A924M	(2014) Standard Specification for General

	Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B766	(1986; R 2008) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C553	(2013) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D3359	(2009; E 2010; R 2010) Measuring Adhesion by Tape Test
ASTM D520	(2000; R 2011) Zinc Dust Pigment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2011; Errata 2012) Motors and Generators
NEMA MG 10	(2013) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2015) 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. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(2012) DoD Minimum Antiterrorism Standards for Buildings

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

40 CFR 82	Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 181	(2013) Factory-Made Air Ducts and Air Connectors

UL 214	(1997; Rev thru Aug 2001) Tests for Flame-Propagation of Fabrics and Films
UL 586	(2009; Reprint Sep 2014) Standard for High-Efficiency Particulate, Air Filter Units
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 900	(2004; Reprint Feb 2012) Standard for Air Filter Units
UL Bld Mat Dir	(2012) Building Materials Directory
UL Electrical Constructn	(2012) 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.

1.3 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

Metallic Flexible Duct
Insulated Nonmetallic Flexible Duct Runouts
Duct Connectors
Duct Access Doors
Manual Balancing Dampers
Diffusers
Registers and Grilles
Centrifugal Fans
In-Line Centrifugal Fans
Propeller Type Power Wall Ventilators
Ceiling Exhaust Fans
Air Handling Units; G

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions
Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

In-Line Centrifugal Fans; G

Propeller Type Power Wall Ventilators; G
Ceiling Exhaust Fans; GAir Handling 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/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 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.

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.

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 performance tests of systems, at least 2 weeks prior to the start of related testing.

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.

2.2 STANDARD PRODUCTS

Except for the fabricated duct, plenums and casings specified in paragraphs "Metal Ductwork" and "Plenums and Casings for Field-Fabricated Units", provide components and equipment that are standard products of manufacturers regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. This requirement applies to all equipment, including diffusers, registers, fire dampers, and balancing dampers.

a. Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.

b. Prior to this two year period, these standard products shall have been sold on the commercial market using advertisements in manufacturers' catalogs or brochures. These manufacturers' catalogs, or brochures shall have been copyrighted documents or have been identified with a manufacturer's document number.

c. 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 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.

2.5 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.

2.6 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.

2.7 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.8 DUCT SYSTEMS

2.8.1 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.

2.8.1.1 Metallic Flexible Duct

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Proved ducts designed for working pressures of two inches water gauge positive and 1.5 inches water gauge negative. Provide flexible round

duct length that does not exceed five feet. Secure connections by applying adhesive for two inches over rigid duct, apply flexible duct two inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of one inch thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.8.1.2 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.8.1.3 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.

2.8.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.8.3 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.

2.8.4 Manual Balancing Dampers

a. 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.

b. 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 access doors or panels in hard ceilings, partitions and walls for access to all concealed damper operators and damper locking setscrews. Coordinate location of doors or panels with other affected contractors.

c. 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.

2.8.4.1 Square or Rectangular Dampers

a. Duct Height 12 inches and Less

(1) Frames:
Maximum 19 inches in width, maximum 12 inches in height; minimum of 20 gauge galvanized steel, minimum of 3 inches long.

More than 19 inches in width, maximum 12 inches in height; Minimum of 16 gauge galvanized steel, minimum of 3 inches long.

(2) Single Leaf Blades:
Maximum 19 inches in width, maximum 12 inches in height; Minimum of 20 gauge galvanized steel, minimum of 3 inches long.

More than 19 inches in width, maximum 12 inches in height; Minimum of 16 gauge galvanized steel, minimum of 3 inches long.

(3) Blade Axles:
To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

Maximum 19 inches in width, maximum 12 inches in height; Galvanized steel, minimum of 3/8 inch square shaft.

More than 19 inches in width, maximum 12 inches in height; Galvanized steel, minimum of 1/2 inch square shaft.

(4) Axle Bearings:
Support the shaft on each end at the frames with shaft bearings. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

Maximum 19 inches in width, maximum 12 inches in height; solid nylon, or equivalent solid plastic, or oil-impregnated bronze bearings.

More than19 inches in width, maximum 12 inches in height; oil-impregnated bronze bearings.

(5) Control Shaft/Hand Quadrant:
Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 50 mm 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

(6) Finish: Mill Galvanized

b. Duct Height Greater than 12 inches

Provide dampers with multi-leaf opposed-type blades.

(1) Frames:
Maximum 48 inches in height; maximum48 inches in width; minimum of 16 gauge galvanized steel, minimum of 5.5 inches long.

(2) Blades:
Minimum of 16 gauge galvanized steel; 6 inch nominal width.

(3) Blade Axles:
To support the blades of round dampers, provide galvanized square steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

(4) Axle Bearings:
Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

(5) Blade Actuator: Minimum 1/2 inch diameter galvanized steel.

(6) Blade Actuator Linkage: Mill Galvanized steel bar and crank

plate with stainless steel pivots.

(7) Control Shaft/Hand Quadrant: Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 50 mm 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

(8) Finish: Mill Galvanized

2.8.4.2 Round Dampers

a. Frames:

4 to 20 inches size: Minimum of 20 gauge galvanized steel, minimum of 10 inches long.

size: Minimum of 20 gauge galvanized steel, minimum of 10 inches long.

32 to 40 inches size: Minimum of 16 gauge galvanized steel, minimum of 10 inches long.

b. Blades:

4 to 20 inches size: Minimum of 20 gauge galvanized steel

22 to 30 inches size: Minimum of 16 gauge galvanized steel

32 to 40 inches size: Minimum of 10 gauge galvanized steel

c. Blade Axles
To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

4 to 20 inches size: Minimum of 3/8 inch square shaft.

22 to 30 inches size: Minimum of 1/2 inch square shaft.

32 to 40 inches size: Minimum of 3/4 inch square shaft.

d. Axle Bearings:
Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

4 to 20 inches size: solid nylon, or equivalent solid plastic, or oil-impregnated bronze.

22 to 30 inches size: solid nylon, or equivalent solid plastic, or oil-impregnated bronze.

32 to 40 inches size: oil-impregnated bronze, or stainless steel

sleeve bearing

e. Control Shaft/Hand Quadrant:
Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

f. Finish: Mill Galvanized

2.8.5 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 or UFC 4-010-01, 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.

2.8.6 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.

2.8.7 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.

2.8.7.1 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.

2.8.7.2 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.

2.8.7.3 Registers

Double-deflection supply registers. Provide manufacturer-furnished volume dampers. Provide volume dampers of the group-operated, opposed-blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face. Automatic volume control devices are acceptable. Provide exhaust and return registers as specified for supply registers, except provide exhaust and return registers that have a single set of nondirectional face bars or vanes having the same appearance as the supply registers.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans2.9.1.1 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary

discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11.

2.9.1.2 Propeller Type Power Wall Ventilators

Provide direct or V-belt driven fans. Provide hinged or removable weathertight fan housing, fitted with framed rectangular base constructed of aluminum or galvanized steel. Furnish motors with nonfusible, horsepower rated, manual disconnect mount on unit. Furnish fans with motor operated low-leakage dampers, birdscreen .

2.9.1.3 Ceiling Exhaust Fans

Provide centrifugal type, direct driven suspended cabinet-type ceiling exhaust fans. Provide fans with acoustically insulated housing. Provide chatter-proof backdraft damper. Provide egg-crate design or louver design integral face grille. Mount fan motors on vibration isolators. Furnish unit with mounting flange for hanging unit from above. Provide U.L. listed fans.

2.9.2 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.9.2.1 Replaceable Media Filters

Provide the dry-media type replaceable media filters, of the size required to suit the application. Provide filtering media that is not less than 2 inches thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Enclose pad in a holding frame of not less than 16 gauge galvanized steel, equipped with quick-opening mechanism for changing filter media. Base the air flow capacity of the filter on net filter face velocity not exceeding 500 fpm, with initial resistance of 0.13 inches water gauge. Provide MERV that is not less than 8 when tested according to ASHRAE 52.2.

2.10 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. 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 D520 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.

2.11 SUPPLEMENTAL COMPONENTS/SERVICES

2.11.1 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate.

2.11.2 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.11.3 Controls

The requirements for controls are as indicated on the drawings.

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.

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. Connect drains indicated to connect to

the sanitary waste system using an indirect waste fitting. 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 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

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.

3.2.6 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.

3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 14calendar days before being loaded.

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 C553, 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 A53/A53M, 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 as specified in Section 07 84 00 FIRESTOPPING.

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.

3.9 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.

3.10 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 1 day 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.

3.11 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. 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.

3.12 OPERATION AND MAINTENANCE

3.12.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data.

3.12.2 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 2 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 --

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 B117	(2011) Standard 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	(2011; Errata 2012) Motors and Generators
NEMA MG 10	(2013) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) 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

1.2 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-03 Product Data

Certification

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, 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 B117, 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 --

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; R 2011) Field Performance Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	(2010; Errata 2011; INT 3 2012; INT 4 2012; INT 5 2013) Ventilation for Acceptable Indoor Air Quality

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002; 6th ed) National Standards for Total System Balance

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV	(2006) Procedural Standards for Measurements and Assessment of Sound and Vibration
NEBB PROCEDURAL STANDARDS	(2005) Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

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

SMACNA 1780	(2002) HVAC Systems - Testing, Adjusting and Balancing, 3rd Edition
SMACNA 1858	(2004) HVAC Sound And Vibration Manual - First Edition
SMACNA 1972 CD	(2012) HVAC Air Duct Leakage Test Manual - 2nd 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.

e. dVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling.

e. NEBB: National Environmental Balancing Bureau

f. 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." 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."

h. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 30 degrees Fahrenheit of the project site's winter outdoor design temperature, throughout the period of TAB data recording.

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.

j. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.

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 systems.

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 1972 CD, 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.

1.3.2 Related Requirements

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

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

TAB Firm; G; G

Designation of TAB team assistants; G

Designation of TAB team engineer; G

SD-03 Product Data

Equipment and Performance Data; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G

SD-06 Test Reports

DALT and TAB Work Execution Schedule; G

DALT and TAB Procedures Summary; G

Pre-Final DALT report; G

Final DALT report; G

TAB report; G

SD-07 Certificates

TAB Firm; G

Independent TAB Agency and Personnel Qualifications; 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.

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, including TAB of environmental systems.

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 both Season 1 and Season 2 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.

i. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

j. 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.

k. 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.

l. 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 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 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. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

(1) Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.

(2) Data may be compiled using direct digital controls trend logging where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the Season I TAB Report Season I and Season 2 TAB Report.

c. 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. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

(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.

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.

Floor Branch Mains: Take readings at floor branch mains served by a main duct vertical riser.

Branch Main Ducts: Take readings at branch main ducts.

d. Duct Traverses: Report duct traverses for main and branch 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."

e. 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.

f. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

g. 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.

h. 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.

1.6 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period not less than 1 year 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 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. 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.

The entire duct system shall be DALT'd.

3.3.4 DALT Testing

Perform DALT on the HVAC duct. Use the duct class, seal class, leakage class and the leak test pressure data of 0.1 inch H_2O to comply with the procedures specified in SMACNA 1972 CD.

In spite of specifications of SMACNA 1972 CD 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.

3.4 TAB PROCEDURES

3.4.1 TAB Reports

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.

3.4.2 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.2.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (water, air quantities, air motion, sound level readings) 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 chillers, boilers, return fans, computer room units, and air handling units (rooftop and central stations).

Group 2: 25 percent of the VAV terminal boxes and associated diffusers and registers.

Group 3: 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.

Group 4: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 5: 25 percent of the supply fans, exhaust fans, and pumps.

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.

3.4.2.2 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.

3.4.2.3 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.

-- 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	(2010; ERTA 2011-2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M	(2014) Standard Specification for Stainless Steel Wire
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C1136	(2012) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1290	(2011) Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C195	(2007; R 2013) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C449	(2007; R 2013) Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C534/C534M	(2014) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C547	(2012) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	(2014) Standard Specification for Cellular Glass Thermal Insulation

ASTM C553	(2013) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C612	(2014) Mineral Fiber Block and Board Thermal Insulation
ASTM C647	(2008; R 2013) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C795	(2008; R 2013) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D774/D774M	(1997; R 2007) Bursting Strength of Paper
ASTM D882	(2012) Tensile Properties of Thin Plastic Sheeting
ASTM E2231	(2014) Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics
ASTM E84	(2014) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2013) Standard Test Methods for Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(2003; Notice 2012) 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; Errata 2006) Standard Method of Test of Surface Burning Characteristics of Building Materials
NFPA 90A	(2015) Standard for the Installation of Air Conditioning and Ventilating Systems

NFPA 90B	(2015) Standard for the Installation of Warm Air Heating and Air Conditioning Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-24179	(1969; Rev A; Am 2 1980; Notice 1 1987) Adhesive, Flexible Unicellular-Plastic Thermal Insulation
MIL-A-3316	(1987; Rev C; Am 2 1990) Adhesives, Fire-Resistant, Thermal Insulation

UNDERWRITERS LABORATORIES (UL)

UL 723	(2008; Reprint Aug 2013) 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 E84. Flame spread, and smoke developed indexes, shall be determined by ASTM E84, 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 E2231. 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 SD types, SD-03 Product Data for system.

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.

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.

1.5 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 C795 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 C534/C534M, 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 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.2 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 E84. Adhesive shall be MIL-A-3316, Class 1, pigmented white red 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 C920, 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 B209, 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 C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

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 E84. 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 monel.

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 B209, 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 E96/E96M; 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 C921, 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 C921, 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 E84.

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 E96/E96M. Meeting UL 723 or ASTM E84 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 E96/E96M utilizing apparatus described in ASTM E96/E96M. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, 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 E84. 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 D882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

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 E96/E96M). Vapor barrier shall meet UL 723 or ASTM E84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with ASTM D774/D774M. 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 C921, 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 E84.

2.2.11 Wire

Soft annealed ASTM A580/A580M 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 E84.

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. Comply with EPA requirements. 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 C552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

b. Flexible Elastomeric Cellular Insulation: ASTM C534/C534M, Grade 1, Type I or II. Type II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation.

2.3.2 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

a. Mineral Fiber: ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Duct Insulation

2.4.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C612, 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 C553, Type 1, Class B-3, 3/4 pcf nominal, 2.0 inches thick or Type II up to 250 degrees F. Also ASTM C1290 Type III may be used.

2.4.2 Duct Insulation Jackets

2.4.2.1 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.

2.4.2.2 Metal Jackets

a. Aluminum Jackets: ASTM B209, 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.

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 and heat tracing 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 as specified in Section 07 84 00 FIRESTOPPING. 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.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

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 at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69.

c. 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.

d. 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.

e. 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 C1136, 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, 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) aluminum jackets shall be utilized. Piping and duct in mechanical rooms shall be rigid.

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
Chilled Water (Supply & Return, Dual Temperature Piping, 40°F nominal)	Cellular Glass	ASTM C552	II	2	No
Hot & Cold Domestic Water Piping, Makeup Water	Mineral Fiber	ASTM C547	I	1	Yes
Drinking Fount Drain Piping	Flex Elast Cell'r	ASTM C534/C534M	I		No
Refrigerant	Flex Elast Cell'r	ASTM C534/C534M	I		No

TABLE 1
Insulation Material For Piping (°F)

Service	Material	Spec-Type-Class	Vapor Retard/ Vapor Barr'r Required
Suction Piping (35°F nominal)			
Exposed Lav'ry Drains, Expo'd Domestic Water Piping & Drains to Areas for Handicap Personnel	Flex Elast Cell'r	ASTM C534/C534M I	No
A/C condensate Drain Located Inside Bldg.	Flex Elast Cell'r	ASTM C534/C534M I	No

TABLE 2
Piping Insulation Thickness (inch and °F)

		Tube And Pipe Size (Inches)				
Service	Material	<1	1- <1.5	1.5- <4	4- <8	>or = to 8
Chilled Water (Supply & Return Piping) (40°F Nominal)	Cellular Glass	1.5	2	2	2.5	3
Heating Hot Water Supply & Return, (Max. 250°F)	Mineral Fiber	1.5	1.5	2	2	2
Hot & Cold Domestic Water Piping, Makeup Water	Mineral Fiber	1	1	1	1	1
Drinking Fountain Drain Piping	Mineral Fiber	1	1	1	1.5	1.5
Refrigerant Suction Piping (35°F nominal)	Flex Elas Cell'r	0.5	0.5	1	N/A	N/A
Exposed Lavatory Drains, Exposed	Flex Elas Cell'r	0.5	0.5	0.5	0.5	0.5

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
Domestic Water Piping & Drains to Areas for Handicap Personnel						
A/C condensate Drain Located Inside Bldg.	Flex Elas Cell'r	1	1	1	N/A	N/A

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. Domestic cold and chilled drinking water.

b. Make-up water.

c. Refrigerant suction lines.

d. Chilled water.

e. Air conditioner condensate drains.

f. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

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. 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.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

a. General. 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. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

b. Precut or Preformed. Precut or preformed insulation shall be placed around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

c. Rigid Preformed. 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".

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.

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

Table 4 - Minimum Duct Insulation (inches)

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. Return air ducts.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes (field-insulated).

l. Supply fans (field-insulated).

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

o. Combustion air intake ducts.

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.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. 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.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

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. Relief air ducts

d. Flexible run-outs (field insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil-headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes.

l. Supply fans.

m. Site-erected air conditioner casings.

n. 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.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

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.

3.3.4 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.

3.3.5 Duct Exposed to Weather

3.3.5.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.5.2 Round Duct

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 or greater than 8 ply, heavy duty, white and natural) membrane shall be applied overlapping material by 3 inches no bands or caulking needed - see manufacturer's recommended installation instructions. Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12 inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with caulking.

3.3.5.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.5.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws.

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.

b. Boiler manholes.

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. Duct mounted coils.

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

3.4.2.2 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. Exposed insulation corners shall be protected with corner angles.

3.4.2.3 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.

3.4.3 Equipment Exposed to Weather

3.4.3.1 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.

3.4.3.2 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 --

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 BD+C (2009; R 2010) Leadership in Energy and Environmental Design(tm) Building Design and 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 Guidelines

SIMILAR TERMS			
Contract Term	ACG	NEBB	TABB
Commissioning Specialist	ACG Certified Commissioning Agent	NEBB Qualified Commissioning Administrator	TABB Certified Commissioning 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 BD+C certification is not required; however, the Contractor is required to provide documentation that meets the LEED BD+C Energy & Atmosphere (EA) Prerequisite 1, Fundamental Commissioning.

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

SD-03 Product Data

Pre-Functional Performance Test Checklists; G
Functional Performance Tests; G

SD-06 Test Reports

Commissioning Report

SD-07 Certificates

Commissioning Firm
Commissioning Specialist

1.5 QUALITY ASSURANCE

1.5.1 Commissioning Firm

Submit certification of the proposed Commissioning Firm's qualifications 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. The firm 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. 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. 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

Submit certification of the proposed Commissioning Specialist's qualifications 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. 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. 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. 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 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, no later than 28 days after the approval of the Commissioning Specialist, 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 Used

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

Designation	Function
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, at least 28 days prior to the start of Pre-Functional Performance Test Checks.. Correct and re-inspect deficiencies discovered during these checks in accordance with the applicable contract requirements. Submit the schedule for the test checks at least 14 days prior to the start of Pre-Functional Performance Test Checks.

3.2.2 Functional Performance Tests

Submit test procedures at least 28 days prior to the start of Functional Performance Tests. Submit the schedule for the tests at least 14 days prior to the start of 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

Submit the Commissioning Report, no later than 14 days after completion of Functional Performance Tests, consisting 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: HPCU-1, HPCU-2, HPCU-3

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 - Unit Heater

For Unit Heater: UH-1, UH-2

Checklist Item	A	M	E	T	C	O
Installation						
a. Hot water piping properly connected.	___	___	X	___	___	___
Electrical						
a. Power available to unit disconnect.	___	___	___	X	___	___
b. Proper motor rotation verified.	___	___	___	X	X	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___
Controls						
a. Control valves properly installed.	___	___	X	___	___	___
b. Control valves operable.	___	___	X	X	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___
Testing, Adjusting, and Balancing (TAB)						
a. TAB Report approved.	___	___	X	___	X	___

Pre-Functional Performance Test Checklist - Exhaust Fan

For Exhaust Fan: EF-1, EF-2, EF-3, EF-4, EF-5

Checklist Item						
Installation	A	M	E	T	C	O
a. Fan belt adjusted.	___	___	X	___	X	___
Electrical	**A**	**M**	**E**	**T**	**C**	**O**
a. Power available to fan disconnect.	___	___	___	X	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___
Controls	**A**	**M**	**E**	**T**	**C**	**O**
a. Control interlocks properly installed.	___	___	___	X	___	___
b. Control interlocks 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	___

Pre-Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: AHU-1, AHU-2, AHU-3

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: AHU-1, AHU-2, AHU-3

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 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._____

c. 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. _____

d. The following shall be verified when the supply and return fans off mode is initiated:

(1) All dampers in normal position._____

(2) All valves in normal position._____

(3) Fan de-energizes. _____

e. 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_____.

f. Verify occupancy schedule is programmed into time clock/UMCS_____.

Functional Performance Test Checklist (cont) - Single Zone Air Handling Unit

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: HPCU-1, HPCU-2, HPCU-3

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 - Unit Heaters

The Contracting Officer will select unit heaters to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent. Hot water systems (for hot water unit heaters) must be in operation and supplying design hot water supply temperature water.

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters:

a. Verify unit heater response to room temperature set point adjustment._____
b. Check heating mode inlet air temperature. _____ deg F
c. Check heating mode outlet air temperature. _____ deg F
d. Record manufacturer's submitted fan capacity _____cfm
e. Calculate unit heater capacity using manufacturer's fan capacity and recorded temperatures and compare to design.
f. 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 --

SECTION 23 54 16.00 10

HEATING SYSTEM; GAS-FIRED HEATERS
04/08

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.66/CGA 6.14	(1996; R 2001) Automatic Vent Damper Devices for Use with Gas-Fired Appliances
ANSI Z83.19/CSA 2.35	(2009; Addenda A 2011; R 2014) Gas-Fired High-Intensity Infrared Heaters

CSA GROUP (CSA)

CSA Directory	(updated continuously online) Product Index

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2011; Errata 2012) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2013) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 54	(2015) National Fuel Gas Code

UNDERWRITERS LABORATORIES (UL)

UL FLAMMABLE & COMBUSTIBLE	(2012) Flammable and Combustible Liquids and Gases Equipment 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-02 Shop Drawings

Detail Drawings
Installation

SD-03 Product Data

Spare Parts

SD-06 Test Reports

Testing, Adjusting, and Balancing

SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions

1.3 QUALITY ASSURANCE

Submit detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the system. Detail drawings for space heating equipment, controls, associated equipment, and for piping and wiring. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

Provide materials and equipment which are standard products of a manufacturer regularly engaged in manufacturing of the products and that essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

2.1.2 Nameplates

Secure a plate to each major component of equipment containing the manufacturer's name, address, type or style, model or serial number, and catalog number. Also, affix an ENERGY STAR label as applicable.

2.1.3 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

2.2 ELECTRICAL WORK

Electrical motor driven equipment shall be provided complete with motors, motor starters, and controls. Motors shall conform to NEMA MG 1. Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics shall be as specified or indicated. Integral size motors shall be premium efficiency type in accordance with NEMA MG 1. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to

drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. 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 HEATERS

Heaters shall be equipped for and adjusted to burn natural gas. Each heater shall be provided with a gas pressure regulator that will satisfactorily limit the main gas burner supply pressure. Heaters shall have an intermittent or interrupted electrically ignited pilot or a direct electric ignition system. Safety controls shall conform to the ANSI standard specified for each heater. Mounting brackets and hardware shall be furnished by the heater manufacturer and shall be factory finished to match the supported equipment.

2.3.1 Infrared Heaters

Heaters shall conform to the requirements of ANSI Z83.19/CSA 2.35 and shall be as indicated. Vented heaters shall be vented to the outside atmosphere. Heater style shall be as indicated. Reflector shape shall be as indicated. Heaters shall be provided with space thermostats which control the unit's burner. Thermostats located in the direct radiation pattern shall be covered with a metal shield.

2.4 THERMOSTATS

Thermostats shall be the adjustable electric or electronic type. Control wiring required to complete the space temperature control system shall be included.

2.5 VENT PIPING

Vent piping shall conform to the requirements of NFPA 54. Plastic material polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.6 INSULATION

Insulation for piping and equipment and application shall be in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.7 FACTORY FINISHES

Equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming thoroughly familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

install equipment as indicated and in accordance with the recommendations

of the equipment manufacturer and the listing agency, except as otherwise specified.

3.2.1 Heating Equipment

Install heaters with clearance to combustibles, complying with minimum distances as determined by CSA Directory, UL FLAMMABLE & COMBUSTIBLE and as indicated on each heater approval and listing plate. Support heaters independently from the building structure, as indicated, but not relying on suspended ceiling systems for support.

3.2.2 Vents

Locate vent dampers, piping and structural penetrations as indicated. Vent damper installation shall conform to ANSI Z21.66/CGA 6.14. Vent pipes, where not connected to a masonry chimney conforming to NFPA 211, shall extend through the roof or an outside wall and shall terminate, in compliance with NFPA 54. Vents passing through waterproof membranes shall be provided with the necessary flashings to obtain waterproof installations.

3.2.3 Gas Piping

Connect gas piping as indicated, complying with the applicable requirements at Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.3 TRAINING

Conduct a training course for the maintenance and operating staff. The training period of 2 hours normal working time shall start after the system is functionally complete but before the final acceptance tests. Give the Contracting Officer at least two weeks advance notice of such training. The training shall include all of the items contained in the approved operation and maintenance instructions as well as demonstrations of routine maintenance operations. Submit 3 complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and basic operating features. Submit 3 complete copies of maintenance instructions listing routine maintenance, possible breakdowns, repairs and troubleshooting guide. The instructions shall include simplified piping, wiring, and control diagrams for the system as installed.

3.4 TESTING, ADJUSTING, AND BALANCING

Perform testing, adjusting, and balancing as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

-- End of Section --

SECTION 23 81 00.00 20

UNITARY AIR CONDITIONING EQUIPMENT
11/09

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 SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34	(2013; Addenda A 2014; ERTA 2014) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 52.2	(2012; Errata 2013; INT 1 2014) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 55	(2010; Errata) Thermal Environmental Conditions for Human Occupancy
ASHRAE 62.1	(2010; Errata 2011; INT 3 2012; INT 4 2012; INT 5 2013) Ventilation for Acceptable Indoor Air Quality

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME B16.22	(2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B31.5	(2013) Refrigeration Piping and Heat Transfer Components

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B280	(2013) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B88	(2014) Standard Specification for Seamless Copper Water Tube

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993; Reaffirmed 2010) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2000; R 2008; E 2010) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA MG 1	(2011; Errata 2012) Motors and Generators

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50502	(Basic) Air Conditioners, (Unitary Heat Pump), Air to Air (3,000 to 300,000 BTU)
FS OO-A-373	(Rev D; Notice 1) Air Conditioners, Single Package Type
FS OO-A-374	(Rev C; Notice 1) Air Conditioners with Remote Condensing Units or Remote Air-Cooled, and Water-Cooled Condenser Units, Unitary

UNDERWRITERS LABORATORIES (UL)

UL 109	(1997; Reprint Aug 2013) Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use
UL 873	(2007; Reprint Aug 2013) Standard for Temperature-Indicating and -Regulating Equipment

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies 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 for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Heat pumps, air to air

Thermostats

Refrigerant piping and accessories

SD-08 Manufacturer's Instructions

Heat pumps, air to air

SD-10 Operation and Maintenance Data

Heat pumps, air to air, Data Package 3

Thermostats, Data Package 2

SD-11 Closeout Submittals

Posted operating instructions

1.4 QUALITY ASSURANCE

1.4.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.4.2 Detail Drawing

For refrigerant piping, submit piping, including pipe sizes. Submit control system wiring diagrams.

1.4.3 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to ANSI/ASHRAE 15 & 34.

1.4.4 Posted Operating Instructions

Submit posted operating instructions for each packaged air conditioning unit.

1.4.5 Sizing

Size equipment based on Design Manual CS from the Air Conditioning Contractors of America; do not oversize.

1.5 REFRIGERANTS

Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Programme. CFCs shall not be permitted. Refrigerant shall be an approved alternative refrigerant per EPA's Significant New Alternative Policy (SNAP) listing.

1.6 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain positive pressure within the building. Ventilation shall meet or exceed ASHRAE 62.1 and all published addenda. Meet or exceed filter media efficiency as tested in accordance with ASHRAE 52.2. Thermal comfort shall meet or exceed ASHRAE 55.

PART 2 PRODUCTS

2.1 HEAT PUMPS, AIR TO AIR

Provide factory assembled units complete with accessories, wiring, piping, and controls. Provide units with supplemental electric heaters with exception of ductless split systems. Ductless split systems shall not have electric heat.

2.1.1 Energy Performance

Minimum SEER shall be as indicated on the schedules.

2.1.2 Air Coils

Extended-surface fin and tube type with seamless copper or aluminum tubes with copper or aluminum fins securely bonded to the tubes. On coils with all-aluminum construction, provide tubes of aluminum alloy 1100, 1200, or 3102; provide fins of aluminum alloy 7072; and provide tube sheets of aluminum alloy 7072 or 5052.

2.1.3 Supplemental Electric Heaters

Provide electrical resistance heaters with the exception of ductless split systems. Heaters shall have a total capacity as indicated. Ductless split systems shall not have electric heat.

2.1.4 Thermostats

Provide adjustable type that conforms to applicable requirements of UL 873. Provide combination heating-cooling type with contacts hermetically sealed against moisture, corrosion, lint, dust, and foreign material. Design to operate on not more than 1.5 degrees Fdifferential and of suitable range calibrated in degrees F. Provide adjustable heat anticipation and fixed cooling anticipation. Provide two independent temperature sensing elements electrically connected to control the compressor and heating equipment, respectively. Accomplish manual switching for system changeover from heating to cooling or cooling to heating and fan operation through the use

of a thermostat subbase. Provide system selector switches to provide "COOL" and "OFF" and "HEAT" and fan selector switches to provide "AUTOMATIC" and "ON." Provide relays, contactors, and transformers located in a panel or panels for replacement and service.

2.1.4.1 Cooling

a. When thermostat is in "COOL" position with fan selector switch in "AUTO" position, compressor, evaporator fan, and condenser fan shall cycle together.

b. When thermostat is in "COOL" position with fan selector switch in "ON" position, compressor, and condenser fan shall cycle together and evaporator fan shall run continuously.

2.1.4.2 Heating

a. When thermostat is in "HEAT" position with fan selector switch in "AUTO" position, heater and supply air fan shall cycle together. Provide a separate thermostat to keep the fan running until the heater cools.

b. When thermostat is in "HEAT" position with fan selector switch in "ON" position, heater shall cycle and supply air fan shall run continuously.

2.1.4.3 Supply Air Fan

a. When fan selector switch is in "AUTO" position with thermostat in "OFF" position, fan shall not run.

b. When fan selector switch is in "ON" position, fan shall run continuously.

2.1.5 Mounting Provisions

Provide units that permit mounting as indicated.

2.2 MOTORS AND STARTERS

NEMA MG 1, NEMA ICS 1, and NEMA ICS 2. Variable speed. Motors less than 1 hp shall meet NEMA High Efficiency requirements. Motors 1 hp and larger shall meet NEMA Premium Efficiency requirements. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Provide motors to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide reduced voltage type motor starters. Provide general-purpose weather-resistant watertight explosion proof type starter enclosures in accordance with NEMA ICS 6.

2.3 REFRIGERANT PIPING AND ACCESSORIES

Provide accessories as specified in FS OO-A-373 and this section. Provide

suction line accumulators as recommended by equipment manufacturer's installation instructions. Provide a filter-drier in the liquid line.

2.3.1 Field-Assembled Refrigerant Piping

Material and dimensional requirements for field-assembled refrigerant piping, valves, fittings, and accessories shall conform to ANSI/ASHRAE 15 & 34 and ASME B31.5, except as herein specified. Factory clean, dehydrate, and seal piping before delivery to the project location. Provide seamless copper tubing, hard drawn, Type K or L, conforming to ASTM B88, except that tubing with outside diameters of 1/4 inch and 3/8 inch shall have nominal wall thickness of not less than 0.030 inch and 0.032 inch, respectively. Soft annealed copper tubing conforming to ASTM B280 may be used where flare connections to equipment are required only in nominal sizes less than one inch outside diameter.

2.3.2 Fittings

ASME B16.22 for solder-joint fittings. UL 109 for flared tube fittings.

2.3.3 Brazing Filler Material

AWS A5.8/A5.8M.

2.3.4 Pipe Hangers and Supports

MSS SP-69 and MSS SP-58, Type 2, except as indicated otherwise.

2.3.5 Pipe Sleeves

Provide sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.

2.3.5.1 Sleeves in Masonry and Concrete Walls, Floors, and Roofs

Provide Schedule 40 or Standard Weight zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 3 inches above finished floor.

2.3.5.2 Sleeves in Partitions and Non-Masonry Structures

Provide zinc-coated steel sheet sleeves having a nominal weight of not less than 0.90 pound per square foot, in partitions and other than masonry and concrete walls, floors, and roofs.

2.4 FINISHES

Provide steel surfaces of equipment including packaged terminal units, heat pumps, and air conditioners, that do not have a zinc coating conforming to ASTM A123/A123M, ASTM A653/A653M, or a duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set anchor bolts and sleeves using templates. Provide anchor bolts of adequate length, and provide with welded-on plates on the head end embedded in the concrete. Level equipment bases, using jacks or steel wedges, and neatly grout-in with a nonshrinking type of grouting mortar. Locate equipment to allow working space for servicing including shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

3.1.1 Unitary Air Conditioning System

Install as indicated, in accordance with requirements of ANSI/ASHRAE 15 & 34, and the manufacturer's installation and operational instructions.

3.2 PIPING

Brazing, bending, forming and assembly of refrigerant piping shall conform to ASME B31.5.

3.2.1 Pipe Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP-58. Installation of hanger types and supports for bare and covered pipes shall conform to MSS SP-69 for the system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58.

3.2.2 Refrigerant Piping

Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure. Braze refrigerant piping with silver solder complying with AWS A5.8/A5.8M. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with emery cloth and keep hot until

solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping shall comply with ASME B31.5.

3.2.3 Returning Oil From Refrigerant System

Install refrigerant lines so that gas velocity in the evaporator suction line is sufficient to move oil along with gas to the compressor. Where equipment location requires vertical risers, line shall be sized to maintain sufficient velocity to lift oil at minimum system loading and corresponding reduction of gas volume. Install a double riser when excess velocity and pressure drop would result from full system loading. Larger riser shall have a trap, of minimum volume, obtained by use of 90- and 45-degree ells. Arrange small riser with inlet close to bottom of horizontal line, and connect to top of upper horizontal line. Do not install valves in risers.

3.2.4 Refrigerant Driers, Sight Glass Indicators, and Strainers

Provide refrigerant driers, sight glass liquid indicators, and strainers in refrigerant piping in accordance with FS OO-A-373 FS OO-A-374 CID A-A-50502 when not furnished by the manufacturer as part of the equipment. Install driers in liquid line with service valves and valved bypass line the same size as liquid line in which dryer is installed. Size of driers shall be determined by piping and installation of the unit on location. Install dryers of 50 cubic inches and larger vertically with the cover for removing cartridge at the bottom. Install moisture indicators in the liquid line downstream of the drier. Indicator connections shall be the same size as the liquid line in which it is installed.

3.2.5 Strainer Locations and Installation

Locate strainers close to equipment they are to protect. Provide a strainer in common refrigerant liquid supply to two or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainer's body.

3.3 AUXILIARY DRAIN PANS, DRAIN CONNECTIONS, AND DRAIN LINES

Provide auxiliary drain pans under units located above finished ceilings or over mechanical or electrical equipment where condensate overflow will cause damage to ceilings, piping, and equipment below. Provide separate drain lines for the unit drain and auxiliary drain pans. Trap drain pans from the bottom to ensure complete pan drainage. Provide drain lines full size of drain opening.

3.4 AIR FILTERS

Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air.

3.5 IDENTIFICATION TAGS AND PLATES

Provide equipment, gages, thermometers, valves, and controllers with tags numbered and stamped for their use. Provide plates and tags of brass or

suitable nonferrous material, securely mounted or attached. Provide minimum letter and numeral size of 1/8 inch high.

3.6 FIELD QUALITY CONTROL

3.6.1 Leak Testing

Upon completion of installation of air conditioning equipment, test factory- and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in ANSI/ASHRAE 15 & 34, except that test pressure shall not exceed 150 psig on hermetic compressors unless otherwise specified as a low side test pressure on the equipment nameplate. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

3.6.2 Evacuation, Dehydration, and Charging

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least one mm Hg absolute. Evacuate system in accordance with the triple-evacuation and blotter method or in accordance with equipment manufacturer's printed instructions and recharge system.

3.6.3 Start-Up and Initial Operational Tests

Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours.

3.6.4 Performance Tests

Upon completion of evacuation, charging, startup, final leak testing, and proper adjustment of controls, test the systems to demonstrate compliance with performance and capacity requirements. Test systems for not less than 8 hours, record readings hourly. At the end of the test period, average the readings, and the average shall be considered to be the system performance.

3.7 WASTE MANAGEMENT

Separate waste in accordance with the Waste Management Plan, placing copper materials in designated areas for reuse. Close and seal tightly all partly used adhesives and solvents; store protected in a well-ventilated, fire-safe area at moderate temperature.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
02/14

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 in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
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

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 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 C80.5	(2005) American National Standard for Electrical Rigid Aluminum Conduit
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2008; E 2010) Standard for

	Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2010) Terminal Blocks
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA MG 1	(2011; Errata 2012) Motors and Generators
NEMA MG 10	(2013) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) 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 ST 20	(1992; R 1997) Standard for Dry-Type Transformers for General Applications
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 TP 1	(2002) Guide for Determining Energy Efficiency for Distribution Transformers
NEMA VE 1	(2009) Standard for Metal Cable Tray Systems
NEMA WD 1	(1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2012) Wiring Devices Dimensions Specifications
NEMA Z535.4	(2011) American National Standard for Product Safety Signs and Labels

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	(2014) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-569	(2012c; Addendum 1 2013; Errata 2013) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-607	(2011b) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

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; Reprint Jul 2012) Machine-Tool Wires and Cables
UL 1203	(2013) UL Standard for Safety Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1283	(2005; Reprint Feb 2013) Electromagnetic Interference Filters
UL 1449	(2014) Surge Protective Devices
UL 1569	(2014) Standard for Metal-Clad Cables
UL 1660	(2014) Liquid-Tight Flexible Nonmetallic Conduit
UL 20	(2010; Reprint Feb 2012) General-Use Snap Switches
UL 360	(2013; Reprint Aug 2014) Liquid-Tight

	Flexible Steel Conduit
UL 44	(2014; Reprint Jun 2014) Thermoset-Insulated Wires and Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2013; Reprint Feb 2014) Wire Connectors
UL 486C	(2013; Reprint Feb 2014) Splicing Wire Connectors
UL 489	(2013; Reprint Mar 2014) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(2012; Reprint Oct 2014) Attachment Plugs and Receptacles
UL 50	(2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 506	(2008; Reprint Oct 2013) Specialty Transformers
UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment
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 514C	(2014) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
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 67	(2009; Reprint Nov 2014) Standard for Panelboards
UL 674	(2011; Reprint Jul 2013) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 6A	(2008; Reprint Nov 2014) Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel

UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel
UL 83	(2014) Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Reprint Nov 2014) Standard for Service-Entrance Cables
UL 869A	(2006) Reference Standard for Service Equipment
UL 943	(2006; Reprint Jun 2012) Ground-Fault Circuit-Interrupters
UL 984	(1996; Reprint Sep 2005) Hermetic Refrigerant Motor-Compressors

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.3 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.

SD-02 Shop Drawings

Panelboards;

Transformers;

Cable trays;

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. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices.

Marking strips drawings;

SD-03 Product Data

Receptacles;

Circuit breakers;

Switches;

Transformers;

Motor controllers;

Manual motor starters;

Telecommunications Grounding Busbar;

Surge protective devices;

Include performance and characteristic curves.

SD-06 Test Reports

600-volt wiring test;

Grounding system test;

Transformer tests;

Ground-fault receptacle test;

SD-09 Manufacturer's Field Reports

Transformer factory tests

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5;

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein.

1.4 QUALITY ASSURANCE

1.4.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "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. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

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 and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide 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.

1.4.2.1 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

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. Include the following:

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

Provide equipment items supported by service organizations that 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

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

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.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

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: cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steelcompression 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.

2.3 CABLE TRAYS

NEMA VE 1. Provide the following:

a. Cable trays: form a wireway system, with a nominal depth as indicated.

b. Cable trays: constructed of aluminum.

c. Cable trays: include splice and end plates, dropouts, and miscellaneous hardware.

d. Edges, fittings, and hardware: finished free from burrs and sharp edges.

e. Fittings: ensure not less than load-carrying ability of straight tray sections and have manufacturer's minimum standard radius.

f. Radius of bends 12 inches.

2.3.1 Basket-Type Cable Trays

Provide of nominal 12, inch width and 2, inch depth with maximum wire mesh spacing of 2 by 4 inch.

2.3.2 Ladder-Type Cable Trays

Provide of nominal 12 inch width with maximum rung spacing of 12 inches.

2.4 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.4.1 Outlet Boxes for Telecommunications System

Provide the following:

a. Standard type 4 inches square by 2 1/8 inches deep.

b. Outlet boxes for wall-mounted telecommunications outlets: 4 by 2 1/8 by 2 1/8 inches deep.

c. Depth of boxes: large enough to allow manufacturers' recommended conductor bend radii.

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.6 WIRES AND CABLES

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

2.6.1 Conductors

Provide the following:

a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.

b. Conductors No. 8 AWG and larger diameter: stranded.

c. Conductors No. 10 AWG and smaller diameter: solid.

d. Conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3: stranded unless specifically indicated otherwise.

e. All conductors: copper.

2.6.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between

components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.6.1.2 Minimum Conductor Sizes

Provide minimum conductor size in accordance with the following:

a. Branch circuits: No. 12 AWG.

b. Class 1 remote-control and signal circuits: No. 14 AWG.

c. Class 2 low-energy, remote-control and signal circuits: No. 16 AWG.

d. Class 3 low-energy, remote-control, alarm and signal circuits: No. 22 AWG.

2.6.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.6.2.1 Ground and Neutral Conductors

Provide color coding of ground and neutral conductors as follows:

a. Grounding conductors: Green.

b. Neutral conductors: White.

c. Exception, where neutrals of more than one system are installed in same raceway or box, other neutrals color coding: white with a different colored (not green) stripe for each.

2.6.2.2 Ungrounded Conductors

Provide color coding of ungrounded conductors in different voltage systems 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

2.6.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, provide power and lighting wires rated for 600-volts, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83;

remote-control and signal circuits: 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.

2.6.4 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6.4.1 Telecommunications Bonding Backbone (TBB)

Provide a copper conductor TBB in accordance with TIA-607 with No. 6 AWG minimum size, and sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG.

2.6.4.2 Bonding Conductor for Telecommunications

Provide a copper conductor Bonding Conductor for Telecommunications between the telecommunications main grounding busbar (TMGB) and the electrical service ground in accordance with TIA-607. Size the bonding conductor for telecommunications the same as the TBB.

2.6.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.6.6 Wire and Cable for 400 Hertz (Hz) Circuits

Insulated copper conductors.

2.6.7 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

2.7 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires: insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.8 DEVICE PLATES

Provide the following:

a. UL listed, one-piece device plates for outlets to suit the devices installed.

b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.

d. Plates on finished walls: satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick.

e. Screws: machine-type with countersunk heads in color to match finish of plate.

f. Sectional type device plates are not be permitted.

g. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.9 SWITCHES

2.9.1 Toggle Switches

NEMA WD 1, UL 20, single pole, three-way, and four-way, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

a. Handles: ivory thermoplastic.

b. Wiring terminals: screw-type, side-wired.

c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.

d. Switches: rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.9.2 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. Utilize Class R fuseholders and fuses for fused switches, unless indicated otherwise. Provide horsepower rated for switches serving as the motor-disconnect means. Provide switches in NEMA, enclosure as indicated per NEMA ICS 6.

2.10 RECEPTACLES

Provide the following:

a. UL 498, hard use (also designated heavy-duty), grounding-type.

b. Ratings and configurations: as indicated.

c. Bodies: ivory as per NEMA WD 1.

d. Face and body: thermoplastic supported on a metal mounting strap.

e. Dimensional requirements: per NEMA WD 6.

f. Screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement.

g. Grounding pole connected to mounting strap.

h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.10.1 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations". Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, polycarbonate, UV resistant/stabilized cover plate.

2.10.2 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.10.3 Special Purpose Receptacles

Receptacles in hangar are special purpose. Provide in ratings indicated.

2.11 PANELBOARDS

Provide panelboards in accordance with the following:

a. UL 67 and UL 50.

b. Panelboards for use as service disconnecting: additionally conform to UL 869A.

c. Panelboards: circuit breaker-equipped.

d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.

e. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated.

f. Directories: indicate load served by each circuit of panelboard.

g. Directories: indicate source of service (upstream panel, switchboard, motor control center, etc.) to panelboard.

h. Type directories and mount in holder behind transparent protective covering.

i. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.11.1 Enclosure

Provide panelboard enclosure in accordance with the following:

a. UL 50.

b. Cabinets mounted outdoors or flush-mounted: hot-dipped galvanized after fabrication.

c. Cabinets: painted in accordance with paragraph PAINTING.

d. Outdoor cabinets: NEMA 3R raintight with conduit hubs welded to the cabinet.

e. Front edges of cabinets: form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front.

f. All cabinets: fabricated such that no part of any surface on the finished cabinet deviates from a true plane by more than 1/8 inch.

g. Holes: provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface.

h. Flush doors: mounted on hinges that expose only the hinge roll to view when the door is closed.

i. Each door: fitted with a combined catch and lock, except that doors over 24 inches long provided with a three-point latch having a knob with a T-handle, and a cylinder lock.

j. Keys: two provided with each lock, with all locks keyed alike.

k. Finished-head cap screws: provided for mounting the panelboard fronts on the cabinets.

2.11.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet. All buses shall be copper.

2.11.3 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.11.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.11.3.2 Circuit Breakers for HVAC Equipment

Provide circuit breakers for HVAC equipment having motors (group or individual) marked for use with HACR type and UL listed as HACR type.

2.11.4 400 Hz Panelboard and Breakers

Provide panelboards and breakers for use on 400 Hz systems rated and labeled "400 Hz."

2.12 TRANSFORMERS

Provide transformers in accordance with the following:

a. NEMA ST 20, general purpose, dry-type, self-cooled, ventilated.

b. Provide transformers in NEMA 1 enclosure.

c. Transformer insulation system:

(1) 220 degrees C insulation system for transformers 15 kVA and greater, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient of 40 degrees C.

(2) 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient of 40 degrees C.

d. Transformer of 150 degrees C temperature rise: capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.

2.12.1 Specified Transformer Efficiency

Transformers, indicated and specified with: 480V primary, 80 degrees C or 115 degrees C temperature rise, kVA ratings of 37.5 to 100 for single phase or 30 to 500 for three phase, energy efficient type. Minimum efficiency, based on factory test results: not be less than NEMA Class 1 efficiency as defined by NEMA TP 1.

2.13 MOTORS

Provide motors in accordance with the following:

a. NEMA MG 1.

b. Hermetic-type sealed motor compressors: Also comply with UL 984.

c. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified.

d. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters.

e. Rate motors for operation on 208-volt, 3-phase circuits with a terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits with a terminal voltage rating of 460 volts.

f. Use motors designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

g. Unless otherwise indicated, use continuous duty type motors if rated 1 HP and above.

h. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

2.13.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors: 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.

2.13.2 Premium Efficiency Polyphase Motors

Select polyphase motors 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 must 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.

2.13.3 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.

2.13.4 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 as specified herein. Power wiring and conduit: conform to the requirements specified herein. Control wiring: provided under, and conform to, the requirements of the section specifying the associated equipment.

2.14 MOTOR CONTROLLERS

Provide motor controllers in accordance with the following:

a. UL 508, NEMA ICS 1, and NEMA ICS 2,.

b. Provide controllers with thermal overload protection in each phase, and one spare normally open auxiliary contact, and one spare normally closed auxiliary contact.

c. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage.

d. Provide protection for motors from immediate restart by a time adjustable restart relay.

e. When used with pressure, float, or similar automatic-type or maintained-contact switch, provide a hand/off/automatic selector switch with the controller.

f. Connections to selector switch: wired such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position.

g. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices: connected in motor control circuit in "hand" and "automatic" positions.

h. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device: made in accordance with indicated or manufacturer's approved wiring diagram.

i. Provide a disconnecting means, capable of being locked in the open position, for the motor that is located in sight from the motor location and the driven machinery location. As an alternative, provide a motor controller disconnect, capable of being locked in the open position, to serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.

j. Overload protective devices: provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case.

k. Cover of combination motor controller and manual switch or circuit breaker: 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.

l. Provide controllers in hazardous locations with classifications as indicated.

2.14.1 Control Wiring

Provide control wiring in accordance with the following:

a. All control wire: stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and passing the VW-1 flame tests included in those standards.

b. Hinge wire: Class K stranding.

c. Current transformer secondary leads: not smaller than No. 10 AWG.

d. Control wire minimum size: No. 14 AWG.

e. Power wiring for 480-volt circuits and below: the same type as control wiring with No. 12 AWG minimum size.

f. Provide wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.14.2 Control Circuit Terminal Blocks

Provide control circuit terminal blocks in accordance with the following:

a. NEMA ICS 4.

b. Control circuit terminal blocks for control wiring: molded or fabricated type with barriers, rated not less than 600 volts.

c. Provide terminals with removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts.

d. Terminals: not less than No. 10 in size with sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal.

e. Terminal arrangement: subject to the approval of the Contracting Officer with not less than four (4) spare terminals or 10 percent, whichever is greater, provided on each block or group of blocks.

f. Modular, pull apart, terminal blocks are acceptable provided they are of the channel or rail-mounted type.

g. Submit data showing that any 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.

2.14.2.1 Types of Terminal Blocks

a. Short-Circuiting Type: Short-circuiting type terminal blocks: furnished for all current transformer secondary leads with provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks: comply with 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: provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. Provide terminals 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, provide screws with hexagonal heads. Conducting parts between connected terminals must have adequate contact surface and cross-section to operate without overheating. Provide eEach connected terminal with the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.14.3 Control Circuits

Control circuits: maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers: conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits: provide 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. Provide one fused secondary lead with the other lead grounded.

2.14.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.14.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers: include compelling relays and multiple-button,

station-type with pilot lights for each speed.

2.14.6 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: heavy duty, oil-tight design.

2.14.7 Pilot and Indicating Lights

Provide LED cluster lamps.

2.15 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single pole designed for surface mounting with overload protection and pilot lights.

2.15.1 Pilot Lights

Provide yoke-mounted, seven element LED cluster light module. Color: amber in accordance with NEMA ICS 2.

2.16 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. Comply with requirements of Division 23, "Mechanical" for mechanical isolation of machines and other equipment.

2.17 TELECOMMUNICATIONS SYSTEM

Provide system of telecommunications wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires cable trays, and other accessories for telecommunications and Community Antenna Television (CATV) System outlets and pathway in accordance with TIA-569 and as specified herein.

2.18 GROUNDING AND BONDING EQUIPMENT

2.18.1 Ground Rods

UL 467. Ground rods: copper-clad steel, with minimum diameter of 3/4 inch and minimum length 10 feet. Sectional ground rods are permitted.

2.18.2 Ground Bus

Copper ground bus: provided in the electrical equipment rooms as indicated.

2.18.3 Telecommunications Grounding Busbar

Provide corrosion-resistant grounding busbar suitable for indoor installation in accordance with TIA-607. Busbars: plated for reduced contact resistance. If not plated, clean the busbar prior to fastening the conductors to the busbar and apply an anti-oxidant to the contact area to control corrosion and reduce contact resistance. Provide a telecommunications main grounding busbar (TMGB) in the telecommunications entrance facility. The telecommunications main grounding busbar (TMGB): sized in accordance with the immediate application requirements and with consideration of future growth. Provide telecommunications grounding

busbars with the following:

a. Predrilled copper busbar provided with holes for use with standard sized lugs,

b. Minimum dimensions of 0.25 in thick by 4 in wide for the TMGB with length as indicated;

c. Listed by a nationally recognized testing laboratory.

2.19 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70: specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations: as indicated. Equipment in hazardous locations: comply with UL 1203 for electrical equipment and industrial controls and UL 674 for motors.

2.20 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment 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.

2.21 FIELD FABRICATED NAMEPLATES

Provide field fabricated nameplates in accordance with the following:

a. ASTM D709.

b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.

c. Each nameplate inscription: identify the function and, when applicable, the position.

d. Nameplates: melamine plastic, 0.125 inch thick, white with black center core.

e. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.

f. Minimum size of nameplates: one by 2.5 inches.

g. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.22 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA 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. Provide marking that is clearly visible to qualified

persons before examination, adjustment, servicing, or maintenance of the equipment.

2.23 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations as required.

2.24 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices (SPD) which comply with UL 1449 at the service entrance, panelboards and as indicated. Provide surge protectors in a NEMA 1 enclosure per NEMA ICS 6. Use Type 1 or Type 2 SPD and connect on the load side of a dedicated circuit breaker.

Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-
Phase to phase (L-L)
Each phase to neutral (L-N)

SPDs at the service entrance: provide with a minimum surge current rating of 80,000 amperes for L-L mode minimum and 40,000 amperes for other modes (L-N, L-G, and N-G) and downstream SPDs rated 40,000 amperes for L-L mode minimum and 20,000 amperes for other modes (L-N, L-G, and N-G).

Provide SPDs per NFPA 780 for the lightning protection system.

Maximum L-N, L-G, and N-G Voltage Protection Rating:

600V for 208Y/120V, three phase system
1,200V for 480Y/277V, three phase system

Maximum L-L Voltage Protection Rating:

1,200V for 208Y/120V, three phase system
1,200V for 480Y/277V, three phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating for L-N and L-G modes of operation: 120% of nominal voltage for 240 volts and below; 115% of nominal voltage above 240 volts to 480 volts.

Provide EMI/RFI filtering per UL 1283 for each mode with the capability to attenuate high frequency noise. Minimum attenuation: 20db.

2.25 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.

b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.

c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.

d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.

e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.

f. Equipment located indoors: ANSI Light Gray, and equipment located outdoors: ANSI Light Gray.

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.26 SOURCE QUALITY CONTROL

2.26.1 Transformer Factory Tests

Submittal: include routine NEMA ST 20 transformer test results on each transformer and also provide the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces: 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: continuous from service entrance equipment to outdoor power system connection.

3.1.2 Hazardous Locations

Perform work in hazardous locations, as defined by NFPA 70, in strict accordance with NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Provide conduit with tapered threads.

3.1.3 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures: labeled and identified as such.

3.1.3.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, label each enclosure, new and existing, as one of several enclosures containing service entrance disconnect devices. Label, at minimum: indicate number of service disconnect devices housed by enclosure and indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure: provided only as permitted by NFPA 70.

3.1.4 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: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 6 inches. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors as required.

3.1.4.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.5 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.

3.1.5.1 Restrictions Applicable to Aluminum Conduit

a. Do not install underground or encase in concrete or masonry.

b. Do not use brass or bronze fittings.

3.1.5.2 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

3.1.5.3 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms,

electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

(6) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.5.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS.

3.1.5.5 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating: extend minimum 6 inches above floor.

3.1.5.6 Conduit Interior to Buildings for 400 Hz Circuits

Aluminum or nonmetallic. Where 400-Hz circuit runs underground or through concrete, provide PVC Schedule 40 conduit.

3.1.5.7 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit 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. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any 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. 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: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installationwith 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 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.

3.1.5.8 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.

3.1.5.9 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. Provide locknuts with sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.5.10 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size: 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.

3.1.5.11 Telecommunications and Signal System Pathway

Install telecommunications pathway in accordance with TIA-569.

a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications room: installed and cabling length requirements in accordance with TIA-568-C.1. Size conduits, wireways, and cable trays in accordance with TIA-569 and as indicated.

b. Backbone Pathway: Telecommunication pathways from the telecommunications entrance facility to telecommunications rooms, and, telecommunications equipment rooms (backbone cabling): installed in accordance with TIA-569. Size conduits, wireways, and cable trays for telecommunications risers in accordance with TIA-569 and as indicated.

3.1.5.12 Community Antenna Television (CATV) System Conduits

Install a system of CATV wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires cable trays, and other accessories for CATV outlets and pathway in accordance with TIA-569. Provide distribution system with star topology with empty conduit and pullwire from each outlet to the headend equipment location.

3.1.6 Cable Tray Installation

Install and ground in accordance with NFPA 70. In addition, install and ground telecommunications cable tray in accordance with TIA-569, and TIA-607. 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. Adjacent cable tray sections: 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. Install conductors run through smoke and fire partitions 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. Firestop penetrations as required. 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.

3.1.7 Telecommunications Cable Support Installation

Install open top and closed ring cable supports on 4 ft to 5 ft centers to adequately support and distribute the cable's weight. Use these types of supports to support a maximum of 50 0.25 in diameter cables. Install suspended cables with at least 3 in of clear vertical space above the ceiling tiles and support channels (T-bars). Open top and closed ring cable supports: suspended from or attached to the structural ceiling or walls with hardware or other installation aids specifically designed to support their weight.

3.1.8 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: 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, or when installed in hazardous areas and when specifically indicated. Boxes in other locations: sheet steel, except that aluminum boxes may be used with aluminum conduit, conduit system. Provide each box with volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures: minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls: square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; provide readily removable fixturesfor 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. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.8.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except

where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets: a minimum of 4 inches square by 2 1/8 inches deep. Mount outlet boxes flush in finished walls.

3.1.8.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or 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.

3.1.8.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.9 Mounting Heights

Mount panelboards, 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 and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Mount other devices as indicated. Measure mounting heights of wiring devices and outlets in non-hazardous areas to center of device or outlet. Measure mounting heights of receptacle outlet boxes in the hazardous area to the bottom of the outlet box.

3.1.10 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with manufacturer's recommendations.

3.1.10.1 Marking Strips

Provide marking strips in accordance with the following:

a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.

b. Use permanent ink for the wire numbers

c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.

d. Size marking strips to accommodate the two sets of wire numbers.

e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking

corresponding to the wire designation used on the Contractor's schematic and connection diagrams.

f. 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, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.

g. 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.

3.1.11 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.12 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.

3.1.13 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings as required.

3.1.14 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, telecommunications system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Interconnect all grounding media in or on the structure to provide a common ground potential. This includes lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Make interconnection to the gas line on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.14.1 Ground Rods

Provide cone pointed ground rods. Measure the resistance to ground using the fall-of-potential method described in IEEE 81. Do not exceed 25 ohms under normally dry conditions for the maximum resistance of a driven ground. If this resistance cannot be obtained with a single rod, additional rods, spaced on center, not less than twice the distance of the length of the rod, or if sectional type rods are used, additional sections may be coupled and driven with the first rod. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.14.2 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. Provide tools and dies as recommended by the manufacturer. Use an embossing die code or other standard method to provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.14.3 Ground Bus

Provide a copper ground bus in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment: effectively grounded by bonding to the ground bus. Bond the ground bus to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Make connections and splices of the brazed, welded, bolted, or pressure-connector type, except use pressure connectors or bolted connections for connections to removable equipment.

3.1.14.4 Resistance

Maximum resistance-to-ground of grounding system: do not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.14.5 Telecommunications System

Provide telecommunications grounding in accordance with the following:

a. Telecommunications Grounding Busbars: Provide a telecommunications main grounding busbar (TMGB) in the telecommunications entrance facility. Install the TMGB as close to the electrical service entrance grounding connection as practicable. Install telecommunications grounding busbars to maintain clearances as required by NFPA 70 and insulated from its support. A minimum of 2 inches separation from the wall is recommended to allow access to the rear of the busbar and adjust the mounting height to accommodate overhead or underfloor cable routing.

b. Telecommunications Bonding Conductors: Provide main telecommunications service equipment ground consisting of separate bonding conductor for telecommunications, between the TMGB and readily accessible grounding connection of the electrical service. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit that exceeds3 feet in length, bond the conductors to each end of the conduit using a grounding bushing or a No. 6 AWG conductor, minimum.

c. Telecommunications Grounding Connections: Telecommunications grounding connections to the TMGB: utilize listed compression two-hole lugs, exothermic welding, suitable and equivalent one hole non-twisting lugs, or other irreversible compression type connections. Bond all metallic pathways, cabinets, and racks for telecommunications cabling and interconnecting hardware located within the same room or space as the TMGB to the TMGB. In a metal frame (structural steel) building, where the steel framework is readily accessible within the room; bond each TMGB to the vertical steel metal frame using a minimum No. 6 AWG conductor. Where the metal frame is external to the room and readily accessible, bond the metal frame to the TMGB with a minimum No. 6 AWG conductor. When practicable because of shorter distances and, where horizontal steel members are permanently electrically bonded to vertical column members, the TGB may be bonded to these horizontal members in lieu of the vertical column members. All connectors used for bonding to the metal frame of a building must be listed for the intended purpose.

3.1.15 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 and are provided under the section specifying the associated equipment.

3.1.16 Repair of Existing Work

Perform repair of existing work, demolition, and modification of existing electrical distribution systems as follows:

3.1.16.1 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.

3.1.16.2 Existing Concealed Wiring to be Removed

Disconnect existing concealed wiring to be removed from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.16.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment includes

equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.

3.1.17 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible. Maximum allowed lead length is 3 feet.

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 test.

3.5.1 Devices Subject to Manual Operation

Operate each device subject to manual operation 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: 250,000 ohms.

3.5.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.5.4 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. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 26 35 43

400-HERTZ (HZ) SOLID STATE FREQUENCY CONVERTER
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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1159	(2009) Recommended Practice on Monitoring Electric Power Quality
IEEE 519	(2014) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
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)

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

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-24021	(1998; Rev K; Notice 1 2014) Electric Power Monitors, External Aircraft
MIL-STD-461	(2007; Rev F) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-704	(2004; Rev F; Notice 1 2008; Notice 2 2013) Aircraft Electric Power Characteristics

UNDERWRITERS LABORATORIES (UL)

UL 1012	(2010; Reprint May 2014) Power Units Other than Class 2
UL 1449	(2014) Surge Protective Devices
UL 489	(2013; Reprint Mar 2014) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1.2 GENERAL REQUIREMENTS

Section 26 20 00INTERIOR DISTRIBUTION SYSTEM, applies to this section with addition and modifications specified herein.

1.3 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

Frequency converter drawings;

SD-03 Product Data

Frequency converter;

SD-06 Test Reports

Work Plan;

Routine Factory Test Plan;

Special Factory Test Plan;

Performance Test Plan;

Test Schedule;

Routine Factory Tests;

Special Factory Tests;

SD-07 Certificates

Qualifications of manufacturer;

UL Listing;

SD-09 Manufacturer's Field Reports

Initial Inspection and Tests;

Performance Tests;

Training Syllabus;

SD-10 Operation and Maintenance Data

Frequency converter, Data Package 5;

Preliminary Operation and Maintenance Manuals, Data Package 5;

1.4 QUALITY ASSURANCE

1.4.1 Frequency Converter Drawings

Furnish scaled drawings of enclosure outline including front, top, side views, and overall dimensions. Provide external power and control wiring and cable connections. Provide single line, schematic, and wiring diagrams. Drawings shall include details of input and output circuit breakers, contactors, rectifiers, surge protectors, and control devices. Drawings shall include conduit entry and exit locations. If parallel operation is included, provide an interconnection diagram.

1.4.2 Qualifications of Manufacturer

Submit a certification that the manufacturer has a minimum of five (5) years' experience in the design, manufacturing, and testing of 400 Hz solid state frequency converters at the same or equivalent kVA and voltage ratings for direct connection to aircraft electrical loads. When specifications require multiple converters operating in parallel, the manufacturer shall provide specific experience with equal or greater kVA rated converters.

The certification shall state that the manufacturer is experienced in manufacturing and testing solid state converters of an equivalent or greater kVA rating. Experience in manufacturing motor generator sets does not qualify as equivalent. Experience in manufacturing portable engine-driven 400-hertz power units does not qualify as equivalent. The manufacturer shall be experienced in producing units for installation in permanent buildings in environmentally closed spaces or in weatherproof enclosures as applicable. The manufacturer shall also document that converters are designed for connection to non-linear loads typically encountered in the aircraft and shipbuilding industries. The manufacturer shall furnish documented experience with converters in various environmental conditions including exterior flight line, hangar, and environmentally enclosed spaces within buildings.

1.4.3 Work Plan

Submit a written schedule of dates of routine and special factory tests, installation, field tests, and operator training for the converter system. Furnish a list of instrumentation equipment for factory and field test reports.

1.4.4 Routine Factory Test Plan

Submit 7 copies of test plans and procedures at least 21 calendar days prior to the tests being conducted. Provide detailed description of test procedures, including test equipment and setups, to be used to ensure the converter meets the performance specification and explain the test methods

to be used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Routine Factory Tests."

1.4.5 Special Factory Test Plan

Submit 7 copies of test plans and procedures with the Routine Factory Test Plan. Provide detailed description of test procedures, including test equipment and setups, used to ensure the converter meets the performance specification and explain the test methods used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Special Factory Tests."

1.4.6 Performance Test Plan

Submit 7 copies of test plans and procedures at least 15 calendar days prior to the start of field tests. Provide detailed description and dates and times scheduled for performance of tests, and detailed description of test procedures, including test equipment (list make and model and provide functional description of the test instruments and accessories) and setups of the tests to be conducted to ensure the converter meets the performance specification. Explain the test methods to be used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Field Quality Control." Test reports shall include power quality measurement data collected in accordance with IEEE 1159.

1.4.7 UL Listing

Submit with the initial submittal to verify qualification of manufacturer. Frequency converter shall be identified with a UL or nationally recognized testing laboratory (NRTL) label prior to shipping.

1.4.7.1 Currently Listed Products

Submit UL or NRTL certification or UL file number for the actual frequency converter to be shipped.

1.4.7.2 Proposed Listed Products

Submit UL or NRTL certification or UL file number for same or similar rating or product size range of like design unit.

1.4.8 Routine Factory Tests Report

Submit within 45 calendar days after completion of tests. Receive approval of test prior to shipping unit. Certify tests were conducted on each converter in accordance with the requirements set forth in paragraph entitled "Routine Factory Tests" and certify converter satisfactorily operated within specified limits. Report shall include copies of the test procedures, test data, and results.

1.4.9 Special Factory Tests Report

Certify tests were conducted on a converter of the same design, construction and kVA and voltage rating to be provided and in accordance with the requirements set forth in paragraph entitled "Special Factory Test" and certify converter operated without malfunctioning within specified limits. Report shall include copies of the test procedures, test data, and results.

1.4.10 Performance Tests Report

Submit report of test results as specified by paragraph entitled "Field Quality Control" within 15 calendar days after completion of tests. Certify tests were conducted on each converter in accordance with the paragraph entitled "Field Quality Control" and certify converter satisfactorily operated within specified limits. Report shall include copies of the test procedures, test data, and results.

1.5 MAINTENANCE

1.5.1 Operation and Maintenance Manuals

Submit frequency converter operation and maintenance manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5.1.1 Additions to Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the following on the actual frequency converter provided:

a. A "one-line diagram" from service entrance to 400 Hz utilization panel or point.

b. A weatherproof, tear-resistant plastic data sheet with operating instructions for each unit including startup, shutdown procedures.

c. Routine and field acceptance test reports.

d. UL or NRTL certification or UL file number.

1.5.1.2 Preliminary Operation and Maintenance Manuals

Prior to scheduling Field Performance Tests, 2 copies of a Preliminary Operation and Maintenance Manual must be submitted to and approved by the Contracting Officer.

1.5.1.3 Extra Material

Furnish recommended manufacturer's spare parts list and schedule of prices for each type of converter and other equipment specified in this section. This list shall include the following:

a. Power semi-conductors

b. Power filter capacitors

c. Plug-in logic cards

d. Output switching modules

e. Fuses

f. Indicator lamp/LED

PART 2 PRODUCTS

2.1 FREQUENCY CONVERTER

Provide frequency converter consisting of modular construction solid-state components for 60 to 400 Hz conversion, input/output devices, and ancillary control devices. Frequency converter shall be a standard product of the manufacturer and shall be the manufacturer's latest design that complies with the specification requirements. The 400 Hz frequency converters provided under this contract shall be products of the same manufacturer. The unit shall have a calculated MTBF exceeding 24,000 hours as calculated when the converter is provided with yearly servicing and maintenance. The converter shall be UL or third party listed to comply with UL 1012. Circuit breakers operating at 400 Hz shall be designed and UL tested for 60 Hz operation and derated for 400 Hz operation. The converter shall use a minimum 12 pulse or active input rectification circuit. Provide startup and shutdown instructions posted on the front of the unit using engraved plastic plate. Provide a plastic encapsulated schematic diagram attached to the inside of the unit in clear view of maintenance personnel.

2.1.1 Electrical Characteristics

2.1.1.1 Input Voltage

480Y/277 V, three phase, four wire, grounded, 60 Hz. Converter shall provide rated output voltage when input voltage is varied plus or minus 10 percent. Input neutral currents shall not exceed 21 percent of any individual phase current at no load and at full load.

2.1.1.2 Input Power Factor

Between 0.8 lagging and unity, under all conditions of steady state line and load variations specified herein.

2.1.1.3 Surge Protection

The converter shall be capable of sustaining an input surge described in and tested in accordance with UL 1449, and IEEE C62.41.1 and IEEE C62.41.2, Location Category B, and continue to operate with no alarms within the specified tolerance.

2.1.1.4 Inrush Current

The inrush current shall not exceed 100 percent of the rated full load input current. Inrush current limitation is based on a frequency converter that does not require a transformer at the input to the unit. Should the contractor choose to provide a frequency converter with a transformer at the input to the unit, the contractor shall be responsible for increasing the size of the upstream feeder breaker(s) and increasing the size of conductors and raceways in accordance with NFPA 70.

2.1.1.5 Input Current Distortion

Input current THD shall not exceed 12-percent of the fundamental with nominal input voltage at full load. Individual harmonic content shall not exceed 8-percent of the fundamental.

2.1.1.6 Output Voltage

200Y/115 V, three phase, 400 Hz, grounded system. The limits overvoltage and undervoltage shall be plus or minus 2 percent. The phase rotation of the output voltage shall be clockwise sequence of A-B-C. Converters shall be designed for compatibility with ship and aircraft power monitors complying with MIL-PRF-24021.

2.1.1.7 Power Output

35 kVA at 0.8 power factor lagging.

2.1.1.8 Load Range

Operate into a linear load with a power factor between 0.5 lagging and 0.8 leading and into a non-linear load with not less than 15 percent current THD, composed of not less than 6 percent of the 3rd harmonic and not less than 7 percent of the 5th harmonic.

2.1.1.9 Efficiency

The 35 kVA units shall have a minimum efficiency of 91 at 50 percent load and 94 at 100 percent load. For a frequency converter that requires a transformer at the input to the unit, reduce the specified efficiencies by 2 percent.

2.1.1.10 No Load Input Losses

The frequency converter shall have no-load input losses no greater than 7 percent of the output kW rating. For a frequency converter that requires a transformer at the input to the unit, increase the specified no load input losses by 2 percent.

2.1.1.11 Overload/Overcurrent

Satisfactory overload/overcurrent operating time is based on no more than one overload in any 4 consecutive hours of operation:

Percent of Full Load	Satisfactory Operating Time
110 percent	60 minutes
125 percent	5 minutes
150 percent	2 minutes
200 percent	20 seconds

After minimum operating time is achieved, unit shall interrupt output power. Unit shall be capable of sustaining the overload/overcurrent without damage until the protective device interrupts the overload/overcurrent.

2.1.1.12 Short Circuit

When a bolted line-to-ground fault, a bolted line-to-line fault, or a bolted three phase fault is applied to the unit, unit shall be capable of

sustaining the short circuit current without damage until the protective device interrupts the fault.

2.1.1.13 Output Voltage THD

a. Balanced load:

(1) Output voltage THD: Not to exceed 3 percent line-to-line and line-to-neutral for linear loads as specified in the paragraph entitled "Load Range".

(2) Output voltage THD: Not to exceed 5 percent line-to-line and line-to-neutral for non-linear loads as specified in the paragraph entitled "Load Range".

(3) Maximum single harmonic distortion: Not to exceed 2 percent of the fundamental at the nominal voltage for linear loads as specified in the paragraph entitled "Load Range".

(4) Maximum single harmonic distortion: Not to exceed 3 percent of the fundamental at the nominal voltage for non-linear loads as specified in the paragraph entitled "Load Range".

b. Unbalanced load: Output voltage THD not to exceed 4 percent, line-to-neutral with 15 percent unbalanced linear load.

2.1.1.14 Output Voltage Amplitude Modulation

Output voltage amplitude modulation shall not exceed 1/2 percent of nominal voltage at no load to full load.

2.1.1.15 Frequency Stability

Provide a high frequency crystal clock to control output frequency of the 400 Hz converter within plus or minus 0.5 percent for all operating conditions, including maximum and minimum specified input voltages, ambient temperature and relative humidity. The frequency regulation shall operate independent of supply frequency and load changes.

2.1.1.16 Phase Angle Regulation

Displacement angle between adjacent voltage phases shall be 120 degrees plus or minus 2 degrees with balanced load and plus or minus 4 degrees with three phase 15 percent unbalanced load. A 15 percent unbalanced load is defined as:

a. Phase A at full rated single phase load.

b. Phase B at 85 percent of Phase A.

c. Phase C at 85 percent of Phase A.

2.1.1.17 Transient Output Voltage Recovery

In accordance with MIL-STD-704.

2.1.2 Environmental Rating

The converter shall operate satisfactorily from no load to rated full load

under the following conditions:

a. Ambient temperatures ranging from 0 degrees C to 55 degrees C.

b. Relative humidity from 0 to 95 percent noncondensing.

c. Ambient pressures from sea level to 3,000 feet.

2.1.3 Monitoring and Control Panel

Provide converter with a control panel that is equipped with the following controls, indicators, instrumentation, data logging, diagnostics, and alarm functions.

2.1.3.1 Controls

a. Start/stop pushbutton.

b. Lamp/light emitting diode (LED) test - A push-to-test button or switch to test indicator lamps/LEDs.

c. Alarm silence - A switch that shall disable the audible alarm.

d. Alarm reset - A pushbutton to silence audible alarms.

e. Emergency power off - A separate pushbutton for emergency power off.

f. Circuit breaker.

2.1.3.2 Indicators

a. Input power available - Lamp/LED to indicate that the supply voltage is available.

b. Output power On/Off - Lamp/LED to indicate that the converter output voltage is available.

c. System alarm - Lamp/LED to indicate that a fault has been detected. This indicator shall be latched in the "ON" position whenever an alarm condition described in paragraph entitled, "Alarm Annunciator," is detected and shall remain "ON" until the alarm reset pushbutton is pressed.

d. Indicating lamp/LED to indicate that the alarm silence switch is in the disable position.

e. Audible alarm.

2.1.3.3 Instrumentation

a. Elapsed time meters (in hours).

b. Output voltmeter selector switch having three phase to neutral positions for monitoring wye voltage outputs in accordance with MIL-STD-704 and one "OFF" position.

c. Output ammeter selector switch having three phase positions and one "OFF" position.

d. Output frequency meter, 395 to 405 HZ scale, having a 400 HZ center with an ON-OFF switch.

2.1.3.4 Alarm Annunciator

The unit shall be capable of detecting the following abnormal conditions, sounding an audible alarm and illuminating individual indicator lamp/LEDs that are clearly identified:

a. Input overvoltage.

b. Input undervoltage.

c. Output undervoltage.

d. Output overvoltage.

e. Output overload.

f. System alarm.

g. Control logic failure.

h. Overtemperature.

i. Logic power supply failure.

2.1.4 Input/Output Devices

Provide fully-rated, three-pole, UL approved devices for control of 60 Hz input and 400 Hz output from the converter. Devices and cables operating at 400 Hz shall be derated in accordance with IEEE 519.

2.1.4.1 Circuit Breaker

Conform to requirements of UL 489. Units operating at 400 Hz shall be derated for 400 Hz operation.

2.1.4.2 Input Circuit Breaker

Provide converter with a UL listed input circuit breaker as an integral part of the converter. Breaker shall be operable from the front of the converter.

2.1.4.3 Output Contactor

Provide converter output with an automatic magnetically-held contactor with interlock circuit. Output contactor shall be of sufficient capacity to handle rated load, overload, and available short circuit current. Contactor shall open when any circuit identified in the paragraph entitled "Protective Control" causes the system to shut down. Output contactor shall be electrically interlocked with ON/OFF circuitry so that when the frequency converter is shut down, the contactor shall open immediately and remain open.

2.1.4.4 Output Circuit Breaker

Provide converter output with a non-automatic manual circuit breaker with appropriate frame size and a shunt trip coil derated for 400 Hz operation.

Circuit breaker shall be tripped by the unit's OFF circuit and when any circuit identified in the paragraph.

2.1.5 Protective Controls

Provide circuitry for the following protective controls.

a. Input undervoltage.

b. Input overvoltage.

c. Loss of phase.

d. Loss of input power.

e. Door interlock - When any access door is opened, the interlock circuitry shall open the 60 Hz input device and 400 Hz output device and not allow the input device to close. For maintenance purposes, provide a bypass switch to defeat the interlock circuitry.

f. Output overvoltage - Protect by tripping output devices for instantaneous overvoltage of 30 percent or more and for 10 to 30 percent overvoltage lasting more than 0.25 second.

g. Output undervoltage - Protect by preventing the closing of the output disconnect until the output voltage is 95 percent of the rated output. If, after closing, the voltage decreases to below 90 percent for longer than 5 seconds, provide relaying to trip output devices utilizing a field-adjustable time-delayed circuit with a range of 4 to 10 seconds.

h. Output frequency - Protect by tripping output devices for frequency change in excess of plus or minus 5 percent of the rated output frequency (400 HZ).

i. Output overload.

j. Converter overtemperature protection.

2.1.6 Electromagnetic Interference Limits

Comply with MIL-STD-461 for Class C2 equipment.

2.1.7 Automatic Line Drop Compensation

Provide automatic line drop compensation - 0 to 7 percent adjustable internally.

2.1.8 Auto Restart

After a total input power outage the unit shall be capable of automatically restarting and re-energizing loads upon restoration of normal power. Provide units with a manual/auto restart switch. If this requirement requires a backup battery power supply this shall be provided. When interlock circuit has been interrupted or when interlock is in the maintenance position manual restart, the system should not restart.

2.1.9 Acoustical Noise

Maximum continuous acoustical noise level shall be 70 dBa (A weighted

scale).

2.1.10 Assembly Construction

Provide enclosures suitable for indoor environments in accordance with NEMA 250, Type 1. Arrange to provide required louvers, cooling air, entry and exit provisions for equipment within enclosures. Construct unit(s) so that components, with the exception of control and monitoring components, are totally enclosed within the enclosure. Electronic circuits including power circuits shall be modular construction readily accessible for maintenance, repair and module replacement from the exterior of the enclosure. Provide permanent identification tags for wiring. Uniquely identify each wire. Use the same identification system in the wiring diagrams in the Operation and Maintenance Manual. Provide each enclosure with a finish coat over a substrate which has been provided with a rust inhibiting treatment. Color shall be the manufacturer's standard color.

2.1.11 Nameplates

As specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SOURCE QUALITY CONTROL

2.2.1 Converter Test Schedule

The Government reserves the right to witness tests. Provide frequency converter 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.

Test Instrument Calibration.

a. The manufacturer shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

b. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

c. Instrument calibration frequency schedule shall not exceed 12 months for both test floor instruments and leased specialty equipment.

d. Dated calibration labels shall be visible on all test equipment.

e. Calibrating standard shall be of higher accuracy than that of the instrument tested.

f. 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:

(1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.2.2 Routine Factory Tests

Routine tests shall be performed by the manufacturer on each of the actual frequency converter(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.

For tests which require full load, use 1.0 power factor unless otherwise noted. All measurements shall be true RMS measurements. Measurements shall be obtained in accordance with IEEE 1159. Tests shall include the following:

a. Input current and power factor: Operate converter at low, nominal and high input voltage at full load. Measure and record input voltage, input power factor and input current in each phase.

b. Output voltage, output voltage THD, output current, output power factor, and voltage regulation: Operate converter at nominal input voltage for:

(1) 50 percent of rated capacity with 0.8 lagging power factor linear load.

(2) 100 percent of rated capacity with 0.5 lagging power factor, 0.8 lagging power factor, 1.0 power factor, and 0.8 leading power factor linear loads.

(3) 50 percent of rated capacity with the non-linear load as specified in the paragraph entitled "Load Range".

(4) 100 percent of rated capacity at low and high input voltage.

(5) 100 percent of rated capacity with the non-linear load as specified in the paragraph entitled "Load Range".

Operate for not less than 10 minutes at each test condition in (1), (2), (3) and (4) above and not less than 30 minutes at test condition in (5) above. Monitor and record output voltage, output voltage THD, output current, output current waveform, output power factor and frequency at the beginning and end of each test condition. Monitor and record output voltage single harmonic distortion for each test condition in (2) and (5) above at the beginning and end of each test condition. Verify output remains within specified regulation limits.

c. Efficiency: Operate at nominal input voltage at half load and full load at 1.0 power factor. Measure and record input voltage, input current, input power factor, output voltage, output current, and output power factor. Calculate the unit efficiency.

d. No load losses: Operate at no load and nominal input voltage. Measure and record input voltage, input current, input power, input power factor, and output voltage.

e. Burn-in Test: Before delivery, burn-in all units under full load conditions for at least 24 hours. Burn-in test shall be performed with the converter enclosure doors closed and all ventilation in the final operating condition.

f. Include harmonic frequency spectrum analysis depicting Harmonic Order and Harmonic Magnitude at the unit's input and output terminals during full load THD test in test reports.

g. Automatic line drop compensation: Operate converter at nominal voltage at:

(1) No-load.

(2) 50 percent of rated capacity with a 0.8 lagging power factor linear load.

(3) 50 percent of rated capacity with the specified non-linear load.

(4) 100 percent of rated capacity with a 0.8 lagging power factor linear load.

(5) 100 percent of rated capacity with the specified non-linear load.

Loads shall be connected to the converter with the specified aircraft power cable assembly. No adjustments to the frequency converter shall be allowed between load tests. Monitor and record output voltage at the load end of the cable. Verify specified performance of the line drop compensation.

2.2.3 Special Factory Tests (Design Tests)

Submit special factory test (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 frequency converter(s). Tests shall be certified and signed by a registered professional engineer. Tests shall be on file based on a production model of converters of the same design, construction and kVA rating provided.

As an option, the manufacturer shall test one unit at the same time scheduled for routine tests, of each rating and size converter to assure compliance with the specification. For all tests which require full load, use 1.0 power factor unless otherwise noted. The tests shall include the following:

a. Surge protection: Apply input surges in accordance with IEEE C62.41.1 and C62.41.2, Location Category B and monitor output. Conduct a minimum of three consecutive successful tests on each unit listed. Confirm there is no interruption to 400 Hz output power and voltage stays within specified regulation tolerances. Surge protection tests shall be applicable on all frequency converter units utilizing same surge protection device by manufacturer and part number regardless of frequency converter kVA size.

b. Inrush current: After applying power to the converter, conduct a minimum of three inrush current tests at full load. Provide copies of waveform and THD analysis in test report.

c. Input current distortion: Operate at nominal input voltage at full load. Measure and record the input current THD for the current in each phase.

d. Overload/overcurrent: Operate at nominal input voltage with loads

listed below:

Percent of Full Load	Minimum Operating Time
110 percent	60 min
125 percent	10 min
150 percent	2 min
200 percent	20 sec

Monitor output to confirm there is no 400 Hz power interruption. After minimum operating time is achieved, unit shall interrupt output power.

e. Short-circuit: Apply a bolted line-to-ground, bolted line-to-line, and bolted three phase fault directly to the output terminals of the unit. Conduct a minimum of three consecutive successful tests on each unit. Provide unit capable of carrying the fault current until the integral system protective devices interrupts the fault with no damage to the unit. Provide waveforms of short circuit current during short circuit tests.

f. Output voltage THD: Operate at nominal input voltage at full load with balanced and 15 percent unbalanced load. A 15 percent unbalanced load is defined as follows:

(1) Phase A at full rated single phase load.

(2) Phase B at 85 percent of Phase A

(3) Phase C at 85 percent of Phase A

Measure and record the output voltage THD for the line-to-neutral voltage of each phase.

g. Phase angle regulation: Operate at full load with balanced and 15 percent unbalanced loads. Measure and record displacement angle between adjacent output voltage phases. A 15 percent unbalanced load is defined as follows:

(1) Phase A at full rated single phase load.

(2) Phase B at 85 percent of Phase A.

(3) Phase C at 85 percent of Phase A.

PART 3 EXECUTION

3.1 INSTALLATION

Install products to operate at 400 Hz in the same manner as specified in other sections of this specification for products operating at 60 Hz, unless indicated or specified otherwise. Conform to the requirements of NFPA 70 and IEEE C2 and to manufacturer's instructions and recommendations.

3.1.1 Equipment

3.1.1.1 Floor Mounted

Provide proper floor mounting channels and install in accordance with the manufacturer's drawings and instructions and as indicated. Align, level, and bolt or weld units to channels to allow easy withdrawal or insertion of removable components and to permit proper operation and maintenance of equipment.

3.1.1.2 Wall Mounted

Bracket mount, but otherwise install as required for floor-mounted units.

3.1.2 Grounding

In accordance with NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.3 Wiring and Conduit

3.1.3.1 Building Wiring

Provide Type XHHW or THHN with stranded copper conductors wiring for 400 Hz circuits. Provide wiring for 400 Hz circuits in non-magnetic conduit, aluminum or PVC. Provide wiring and conduit for 60 Hz circuits as specified in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM.

3.1.3.2 Conduit

Use aluminum conduit for exposed feeders. Do not install aluminum conduit underground or encased in concrete. Use aluminum fittings and boxes with aluminum conduit. For underground or concrete encasement use PVC.

3.1.4 Manufacturer's Representative

The manufacturer's representative shall place the system in operation and make necessary adjustments to ensure optimum operation of the equipment. The manufacturer's representative shall have at least 2 years of practical experience in the installation and testing of 400 Hz solid state frequency converters.

3.2 FIELD QUALITY CONTROL

3.2.1 Instruments

Provide test instruments capable of measuring and recording or displaying test data at a higher resolution and greater accuracy than specified for the converter's performance. The test instruments used in the field tests shall have current valid calibration stickers issued by an approved calibration laboratory. Verify calibration and adjustments of converter instruments provided prior to field tests. Instruments shall be calibrated for 400 Hz operation when measuring 400 Hz signals.

3.2.2 Performance of Acceptance Checks and Tests

Perform field tests and conduct inspections. Provide labor, equipment tests instruments, and incidentals required for the tests including load banks, except the Government will furnish electricity. For all electrical

load tests, use 1.0 power factor.

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests.

3.2.3 Initial Inspection and Tests

a. Compare equipment nameplate information with specifications and approved shop drawings.

b. Inspect physical and mechanical condition.

c. 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.

d. Perform specific inspections and mechanical tests as recommended by manufacturer.

e. Verify correct equipment grounding.

f. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

3.2.4 Performance Tests

Conduct converter performance tests under the supervision of the manufacturer's representative. Successfully complete the preliminary operation, control and protective devices check prior to performing load and transient tests. If the converter fails to operate within the specified limits during any of the performance tests the Contractor shall discontinue the test and shall make necessary repairs to correct the failure and restart testing of the converter.

3.2.4.1 Preliminary Operation

Inspect the converter and make adjustments necessary to assure proper operation in accordance with the manufacturer's instructions. Operate frequency converter at 0, 25, 50, 75, and 100 percent of rated full load. Measure and record the output voltage, current, frequency, and THD at each load. Calculate output voltage regulation. Verify converter is operating within specified limits at each load level.

3.2.4.2 Control and Protective Device Checks

Operate each control, switch, input/output device that is capable of being operated manually a minimum of three times, demonstrating satisfactory operation each time. Perform operation test on each protective device to ensure that devices functions properly. After each operation measure and record the converter output frequency, voltage and current. Verify converter is operating within specified limits.

3.2.4.3 Load Test

Operate each unit continuously a minimum of 2 hours at 100 percent rated load. Measure and record the converter output frequency, voltage and current. Verify converter is operating within specified limits. Load test shall be performed with the converter doors closed.

3.2.4.4 Transient Tests

Transient recovery: Operate at the following load steps: 0 to 100 percent, 0 to 50 percent, 100 to 0 percent, and 50 to 0 percent. Provide recordings or displays of voltage and frequency during each transient test, and indicate on the recordings and displays the time intervals and acceptable limits for voltage and frequency. Repeat each transient test three times, record the results of each test. Verify converter is operating within specified limits.

3.2.4.5 Harmonic Distortion Tests

Perform output voltage harmonic distortion tests at the output of the converter terminals at 0 percent load and 100 percent load at unity power factor. The Contractor shall provide test equipment and instrumentation required for the tests. Tests shall be conducted with a distortion analyzer with test leads within 3 feet of the frequency converter's output terminals. Test data shall include total harmonic distortion amplitudes of all individual harmonics presented in a spectrum analysis format up to the 37th order.

3.2.4.6 Automatic Line Drop Compensation

Conduct automatic line drop compensation tests on each converter with the load connected to the converter with the specified aircraft power cable assembly. Operate each converter at no load, 50 percent and 100 percent of the rated capacity. No adjustments to the frequency converter shall be allowed between load tests. Monitor and record output voltage at the load end of the cable. Verify specified performance of the line drop compensation.

3.2.5 Grounding System

Inspect ground system for compliance with contract plans and specifications.

3.2.6 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.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

Provide field training to Government personnel on the operation and maintenance of the converter provided. Provide field training 2 weeks prior to the scheduled date for field acceptance tests. As a minimum the training shall include 2 hours of instruction on the theory of operation and 4 hours on the repair and maintenance of the converters. The instructor shall be approved by the manufacturer of the unit provided. Submit training syllabus including each topic of training and a brief outline of each topic to the Contracting Officer at least 4 weeks prior to training for approval. Training shall be approved by the Contracting

Officer at least 2 weeks in advance. The Government may record, video and audio, the training sessions and use these recordings to train personnel on the operation and maintenance of the converter system. Provide two copies of video or audio tapes, if used in the training sessions, to the Contracting Officer.

-- End of Section --

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM
11/13

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 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

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 780	(2014) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment
UL 96	(2005; Reprint Sep 2013) Standard for Lightning Protection Components
UL Electrical Constructn	(2012) Electrical Construction Equipment Directory

1.2 RELATED REQUIREMENTS

1.2.1 Verification of Dimensions

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before making any departures from the design.

1.2.2 System Requirements

Provide a system furnished under this specification consisting of the latest UL Listed products of a manufacturer regularly engaged in production of lightning protection system components. Comply with NFPA 70, NFPA 780, and UL 96.

1.2.3 Lightning Protection System Installers Documentation

Provide documentation showing that the installer is certified with a

commercial third-party inspection company whose sole work is lightning protection, or is a UL Listed Lightning Protection Installer. In either case, the documentation must show that they have completed and passed the requirements for certification or listing, and have a minimum of 2 years documented experience installing lightning protection systems for DoD projects of similar scope and complexity.

1.3 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

Overall lightning protection system;

Each major component;

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan;

Lightning Protection and Grounding System Test;

SD-07 Certificates

Lightning Protection System Installers Documentation;

Component UL Listed and Labeled;

Lightning protection system inspection certificate;

Roof manufacturer's warranty;

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "must" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.4.1 Installation Drawings

1.4.1.1 Overall System Drawing

Submit installation shop drawing for the overall lightning protection system. Include on the drawings the physical layout of the equipment (plan view and elevations), mounting details, relationship to other parts of the work, and wiring diagrams.

1.4.1.2 Major Components

Submit detail drawings for each major component including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 Component UL Listed and Labeled

Submit proof of compliance that components are UL Listed and Labeled. Listing alone in UL Electrical Constructn, which is the UL Electrical Construction Directory, is not acceptable evidence. In lieu of Listed and Labeled, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.4.3 Lightning Protection and Grounding System Test Plan

Provide a lightning protection and grounding system test plan. Detail both the visual inspection and electrical testing of the system and components in the test plan. Identify (number) the system test points/locations along with a listing or description of the item to be tested and the type of test to be conducted. As a minimum, include a sketch of the facility and surrounding lightning protection system as part of the specific test plan for each structure. Include the requirements specified in paragraph, "Testing of Integral Lightning Protection System" in the test plan.

1.4.4 Lightning Protection System Inspection Certificate

Provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780.

Inspection must cover every connection, air terminal, conductor, fastener, accessible grounding point and other components of the lightning protection system to ensure 100% system compliance. This includes witnessing the tests for the resistance measurements for ground rods with test wells, and for continuity measurements for bonds. It also includes verification of proper surge protective devices for power, data and telecommunication systems. Random sampling or partial inspection of a facility is not acceptable.

1.5 SITE CONDITIONS

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before changing the design.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings, such as tin or lead, or oversize conductors. Where a mechanical hazard is involved, increase conductor size to compensate for the hazard or protect conductors. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic). All lightning protection components, such as bonding plates, air terminals, air terminal supports and braces, chimney bands, clips, connector fittings, and fasteners are to comply with the requirements of UL 96 classes as applicable.

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.1.2 Copper Only

Provide copper conductors, except where aluminum conductors are required for connection to aluminum equipment.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide solid air terminals with a blunt tip. Tubular air terminals are not permitted. Support air terminals more than 24 inches in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods made of copper-clad steel conforming to conform to UL 467. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length. Do not mix ground rods of copper-clad steel or solid copper on the job.

2.2.3 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.4 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780 and UL 96.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Provide a lightning protection system that meets the requirements of NFPA 780. Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, and grounding electrodes and ground ring electrode conductor. Bond secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or below the level of the grounded metallic parts.

3.1.1 Roof-Mounted Components

Coordinate with the roofing manufacturer and provide certification that the roof manufacturer's warranty is not violated by the installation methods for air terminals and roof conductors.

3.1.1.1 Air Terminals

Use adhesive shoes with adhesive approved by the roof manufacturer when installing air terminals on "rubber" (EPDM) type roofs. Use a standing

seam base for installation of air terminals on a standing seam metal roof that does not produce any roof penetrations.

3.1.1.2 Roof Conductors

Use adhesive shoes with adhesive approved by the roof manufacturer when installing roof conductors on "rubber" (EPDM) type roofs. Use a standing seam base for installation of roof conductors on a standing seam metal roof that does not produce any roof penetrations.

3.1.2 Down Conductors

Protect exposed down conductors from physical damage as required by NFPA 780. Use Schedule 80 PVC to protect down conductors. Paint the Schedule 80 PVC to match the surrounding surface with paint that is approved for use on PVC.

3.1.3 Ground Connections

Attach each down conductor and ground ring electrode to ground rods by welding (including exothermic), brazing, or compression. All connections to ground rods below ground level must be by exothermic weld connection or with a high compression connection using a hydraulic or electric compression tool to provide the correct circumferential pressure. Accessible connections above ground level and in test wells can be accomplished by mechanical clamping.

3.1.4 Grounding Electrodes

Extend driven ground rods vertically into the existing undisturbed earth for a distance of not less 10 feet. Set ground rods not less than 3 feet nor more than 8 feet, from the structure foundation, and at least beyond the drip line for the facility. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum allowed resistance of a driven ground rod is 25 ohms, under normally dry conditions. Contact the Contracting Officer for direction on how to proceed when two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground ring electrode, provide continuous No. 1/0 bare stranded copper cable. Lay ground ring electrode around the perimeter of the structure in a trench not less than 3 feet nor more than 8 feet from the nearest point of the structure foundation, and at least beyond the drip line for the facility. Install ground ring electrode to a minimum depth of 30 inches. Install a ground ring electrode in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable.

3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so that they are electrically continuous, having a surface contact of at least 3 square inches.

3.2.2 Personnel Ramps and Covered Passageways

Place a down conductor and a driven ground at one of the corners where the

ramp connects to each building or structure. Connect down conductor and driven ground to the ground ring electrode or nearest ground connection of the building or structure. Where buildings or structures and connecting ramps are clad with metal, separately bond the metal of the buildings and ramps to a down conductor as close to grade as possible.

3.3 INTERFACE WITH OTHER STRUCTURES

3.3.1 Fences

Bond metal fence and gate systems to the lightning protection system whenever the fence or gate is within 6 feet of any part of the lightning protection system in accordance with ANSI C2.

3.3.2 Exterior Overhead Systems

Bond to the nearest down conductor as close to grade as possible. This includes overhead pipes, conduits, cable trays, or any other metallic objects on the exterior of the building that enter a building. In addition, bond pipes, conduits, and cable trays to any metallic objects (such as steel structural support of air handling units or cooling towers) that are within 6 feet.

3.4 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore, to original condition, the areas disturbed by trenching, storing of dirt, cable laying, and other work. Overfill to accommodate for settling. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.5 FIELD QUALITY CONTROL

3.5.1 Lightning Protection and Grounding System Test

Test the lightning protection and grounding system to ensure continuity is not in excess of 1 ohm and that resistance to ground is not in excess of 25 ohms. Provide documentation for the measured values at each test point. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of test points, measured values for continuity and ground resistances, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

-- End of Section --

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM
11/13

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 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

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 780	(2014) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment
UL 96	(2005; Reprint Sep 2013) Standard for Lightning Protection Components
UL Electrical Constructn	(2012) Electrical Construction Equipment Directory

1.2 RELATED REQUIREMENTS

1.2.1 Verification of Dimensions

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before making any departures from the design.

1.2.2 System Requirements

Provide a system furnished under this specification consisting of the latest UL Listed products of a manufacturer regularly engaged in production of lightning protection system components. Comply with NFPA 70, NFPA 780, and UL 96.

1.2.3 Lightning Protection System Installers Documentation

Provide documentation showing that the installer is certified with a

commercial third-party inspection company whose sole work is lightning protection, or is a UL Listed Lightning Protection Installer. In either case, the documentation must show that they have completed and passed the requirements for certification or listing, and have a minimum of 2 years documented experience installing lightning protection systems for DoD projects of similar scope and complexity.

1.3 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

Overall lightning protection system;

Each major component;

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan;

Lightning Protection and Grounding System Test;

SD-07 Certificates

Lightning Protection System Installers Documentation;

Component UL Listed and Labeled;

Lightning protection system inspection certificate;

Roof manufacturer's warranty;

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "must" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.4.1 Installation Drawings

1.4.1.1 Overall System Drawing

Submit installation shop drawing for the overall lightning protection system. Include on the drawings the physical layout of the equipment (plan view and elevations), mounting details, relationship to other parts of the work, and wiring diagrams.

1.4.1.2 Major Components

Submit detail drawings for each major component including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 Component UL Listed and Labeled

Submit proof of compliance that components are UL Listed and Labeled. Listing alone in UL Electrical Constructn, which is the UL Electrical Construction Directory, is not acceptable evidence. In lieu of Listed and Labeled, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.4.3 Lightning Protection and Grounding System Test Plan

Provide a lightning protection and grounding system test plan. Detail both the visual inspection and electrical testing of the system and components in the test plan. Identify (number) the system test points/locations along with a listing or description of the item to be tested and the type of test to be conducted. As a minimum, include a sketch of the facility and surrounding lightning protection system as part of the specific test plan for each structure. Include the requirements specified in paragraph, "Testing of Integral Lightning Protection System" in the test plan.

1.4.4 Lightning Protection System Inspection Certificate

Provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780.

Inspection must cover every connection, air terminal, conductor, fastener, accessible grounding point and other components of the lightning protection system to ensure 100% system compliance. This includes witnessing the tests for the resistance measurements for ground rods with test wells, and for continuity measurements for bonds. It also includes verification of proper surge protective devices for power, data and telecommunication systems. Random sampling or partial inspection of a facility is not acceptable.

1.5 SITE CONDITIONS

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before changing the design.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings, such as tin or lead, or oversize conductors. Where a mechanical hazard is involved, increase conductor size to compensate for the hazard or protect conductors. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic). All lightning protection components, such as bonding plates, air terminals, air terminal supports and braces, chimney bands, clips, connector fittings, and fasteners are to comply with the requirements of UL 96 classes as applicable.

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.1.2 Copper Only

Provide copper conductors, except where aluminum conductors are required for connection to aluminum equipment.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide solid air terminals with a blunt tip. Tubular air terminals are not permitted. Support air terminals more than 24 inches in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods made of copper-clad steel conforming to conform to UL 467. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length. Do not mix ground rods of copper-clad steel or solid copper on the job.

2.2.3 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.4 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780 and UL 96.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Provide a lightning protection system that meets the requirements of NFPA 780. Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, and grounding electrodes and ground ring electrode conductor. Bond secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or below the level of the grounded metallic parts.

3.1.1 Roof-Mounted Components

Coordinate with the roofing manufacturer and provide certification that the roof manufacturer's warranty is not violated by the installation methods for air terminals and roof conductors.

3.1.1.1 Air Terminals

Use adhesive shoes with adhesive approved by the roof manufacturer when installing air terminals on "rubber" (EPDM) type roofs. Use a standing

seam base for installation of air terminals on a standing seam metal roof that does not produce any roof penetrations.

3.1.1.2 Roof Conductors

Use adhesive shoes with adhesive approved by the roof manufacturer when installing roof conductors on "rubber" (EPDM) type roofs. Use a standing seam base for installation of roof conductors on a standing seam metal roof that does not produce any roof penetrations.

3.1.2 Down Conductors

Protect exposed down conductors from physical damage as required by NFPA 780. Use Schedule 80 PVC to protect down conductors. Paint the Schedule 80 PVC to match the surrounding surface with paint that is approved for use on PVC.

3.1.3 Ground Connections

Attach each down conductor and ground ring electrode to ground rods by welding (including exothermic), brazing, or compression. All connections to ground rods below ground level must be by exothermic weld connection or with a high compression connection using a hydraulic or electric compression tool to provide the correct circumferential pressure. Accessible connections above ground level and in test wells can be accomplished by mechanical clamping.

3.1.4 Grounding Electrodes

Extend driven ground rods vertically into the existing undisturbed earth for a distance of not less 10 feet. Set ground rods not less than 3 feet nor more than 8 feet, from the structure foundation, and at least beyond the drip line for the facility. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE 81. Maximum allowed resistance of a driven ground rod is 25 ohms, under normally dry conditions. Contact the Contracting Officer for direction on how to proceed when two of any three ground rods, driven not less than 10 feet into the ground, a minimum of 10 feet apart, and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground ring electrode, provide continuous No. 1/0 bare stranded copper cable. Lay ground ring electrode around the perimeter of the structure in a trench not less than 3 feet nor more than 8 feet from the nearest point of the structure foundation, and at least beyond the drip line for the facility. Install ground ring electrode to a minimum depth of 30 inches. Install a ground ring electrode in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang, or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable.

3.2 APPLICATIONS

3.2.1 Nonmetallic Exterior Walls with Metallic Roof

Bond metal roof sections together which are insulated from each other so that they are electrically continuous, having a surface contact of at least 3 square inches.

3.2.2 Personnel Ramps and Covered Passageways

Place a down conductor and a driven ground at one of the corners where the

ramp connects to each building or structure. Connect down conductor and driven ground to the ground ring electrode or nearest ground connection of the building or structure. Where buildings or structures and connecting ramps are clad with metal, separately bond the metal of the buildings and ramps to a down conductor as close to grade as possible.

3.3 INTERFACE WITH OTHER STRUCTURES

3.3.1 Fences

Bond metal fence and gate systems to the lightning protection system whenever the fence or gate is within 6 feet of any part of the lightning protection system in accordance with ANSI C2.

3.3.2 Exterior Overhead Systems

Bond to the nearest down conductor as close to grade as possible. This includes overhead pipes, conduits, cable trays, or any other metallic objects on the exterior of the building that enter a building. In addition, bond pipes, conduits, and cable trays to any metallic objects (such as steel structural support of air handling units or cooling towers) that are within 6 feet.

3.4 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore, to original condition, the areas disturbed by trenching, storing of dirt, cable laying, and other work. Overfill to accommodate for settling. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.5 FIELD QUALITY CONTROL

3.5.1 Lightning Protection and Grounding System Test

Test the lightning protection and grounding system to ensure continuity is not in excess of 1 ohm and that resistance to ground is not in excess of 25 ohms. Provide documentation for the measured values at each test point. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of test points, measured values for continuity and ground resistances, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

-- End of Section --

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.

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 A580/A580M	(2014) Standard Specification for Stainless Steel Wire
ASTM A641/A641M	(2009a; R 2014) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B633	(2013) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

CALIFORNIA ENERGY COMMISSION (CEC)

CEC Title 24	(2008; Effective Jan 2010) California's Energy Efficiency Standards for Residential and Nonresidential Buildings

GREEN SEAL (GS)

GS-12	(1997) Occupancy Sensors

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 C78.41	(2006) For Electric Lamps--Guidelines for Low-Pressure Sodium Lamps
ANSI ANSLG C78.42	(2009) For Electric Lamps: High-Pressure Sodium 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)
ANSI/ANSLG C78.43	(2013) American National Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
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 ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

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

1.4.1 Lighting Control System

Provide lighting control system as indicated. Lighting control equipment shall include, if indicated: control modules, power packs, dimming ballasts, occupancy sensors, and light level sensors.

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;

Fluorescent electronic ballasts;

Fluorescent lamps;

High-intensity-discharge (HID) lighting fixtures;

HID ballasts;

High-pressure sodium (HPS) lamps; G

Low-pressure sodium lamps; G

Metal-halide lamps;

Lighting contactor;

Photocell switch;

Exit signs;

Emergency lighting equipment;

Occupancy sensors;

Electronic dimming ballast;

Energy Efficiency

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5;

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, control modules, control zones, occupancy sensors, light level sensors, power packs, dimming ballasts, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

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 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.

1.6.3.2 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products.

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 programmed start unless otherwise indicated. Programmed start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

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 10 percent (maximum).

b. Input wattage.

1. 62 watts (maximum) when operating two F32T8 lamps

2. 92 watts (maximum) when operating three F32T8 lamps

c. Ballast efficacy factor.

1. 1.44 (minimum) when operating two F32T8 lamps

2. 0.93 (minimum) when operating three F32T8 lamps

d. Provide three lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

2.1.2 Fluorescent Lamp Electronic Dimming Ballast

2.1.2.1 T-8 Lamp Ballast

Input wattage, for indicated lamp quantity shall be:

a. 70 watts (maximum) when operating two F32T8 lamps.

b. 104 watts (maximum) when operating three F32T8 lamps.

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 4100K, and an average rated life of 20,000 hours.

Average rated life is based on 3 hours operating per start.

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 Low-Pressure Sodium Lamps

ANSI ANSLG C78.41.

2.2.4 Metal-Halide Lamps

a. Single-ended, wattage as indicated, conforming to ANSI/ANSLG C78.43

2.2.4.1 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

c. Upward efficiency greater than 20 percent

1. 150-399 watts: minimum 62 LER for closed fixture; minimum 77 for open 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. Brace pendants 4 feet or longer provided in shops or hangers to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 0.18 inch diameter.

2.4 SWITCHES

2.4.1 Toggle Switches

Provide toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.5 LIGHTING CONTACTOR

NEMA ICS 2, mechanically held contactor.

2.6 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 277 volts ac, 60 Hz with single pole double-throw (SPDT) contacts for control of mechanically held contactors, rated 1000 W. Switch shall turn on at or below 3 footcandles and off at 2 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide switch:

a. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

2.7 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.

2.7.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, integral self-testing module and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum). The light emitting diodes shall have rated lamp life of 70,000 hours (minimum).

2.8 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated.

2.8.1 Fluorescent Emergency System

Each system shall consist of an automatic power failure device, test switch operable from outside of the fixture, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Provide self-testing module integral to the fixture. Charger shall be either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to 1 lamps for 90 minutes at a minimum of 1100 lumens per lamp output. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years. Emergency ballasts provided with fixtures containing solid-state ballasts shall be fully compatible with the solid-state ballasts.

2.9 SELF-TESTING MODULE

Self-testing module for exit signs and emergency lighting equipment shall perform the following functions:

a. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.

b. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load.

c. Manual test switch to simulate a discharge test cycle.

d. Module shall have low voltage battery disconnect (LVD) and brown-out protection circuit.

2.10 OCCUPANCY SENSORS

UL listed. Comply with GS-12. Occupancy sensors and power packs shall be designed to operate on the voltage indicated. Sensors and power packs shall have circuitry that only allows load switching at or near zero current crossing of supply voltage. Occupancy sensor mounting as indicated. Sensor shall have an LED occupant detection indicator. Sensor shall have adjustable sensitivity and adjustable delayed-off time range of 5 minutes to 15 minutes. Wall mounted sensors shall match the color of adjacent wall plates as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, ceiling mounted sensors shall be white. Ceiling mounted sensors shall have 360 degree coverage unless otherwise indicated.

a. Ultrasonic sensor shall be crystal controlled and shall not cause detection interference between adjacent sensors.

b. Infrared sensors shall have a daylight filter. Sensor shall have a fresnel lens that is applicable to space to be controlled.

c. Ultrasonic/Infrared Combination Sensor

Occupancy detection to turn lights on requires both ultrasonic and infrared sensor detection. Lights shall remain on if either the ultrasonic or infrared sensor detects movement. Infrared sensor shall have lens selected for indicated usage and daylight filter to prevent short wavelength infrared interference. Ultrasonic sensor frequency shall be crystal controlled.

2.11 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.11.1 Wires

ASTM A641/A641M, galvanized regular coating, soft temper, 0.1055 inches in diameter (12 gage).

2.11.2 Wires, for Humid Spaces

ASTM A580/A580M, composition 302 or 304, annealed stainless steel 0.1055 inches in diameter (12 gage).

2.11.3 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

2.11.4 Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.12 EQUIPMENT IDENTIFICATION

2.12.1 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.

2.12.2 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.

2.13 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.

3.1.5 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.1.6 Occupancy Sensor

Provide quantity of sensor units indicated as a minimum. Provide

additional units to give full coverage over controlled area. Full coverage shall provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways. Locate the sensor(s) as indicated and in accordance with the manufacturer's recommendations to maximize energy savings and to avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage. Set sensor "on" duration to 10 minutes.

3.1.7 Light Level Sensor

Locate light level sensor as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for 50 footcandles or for the indicated light level at the typical work plane for that area.

3.2 FIELD 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 Occupancy Sensor

Test sensors for proper operation. Observe for light control over entire area being covered.

-- End of Section --

SECTION 28 31 64.00 10

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE
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.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.41	(1990; R 2008) Audible Emergency Evacuation Signal (ASA 96)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

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 FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1221	(2013) Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems
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 72	(2013) National Fire Alarm and Signaling Code
NFPA 90A	(2015) Standard for the Installation of Air Conditioning and Ventilating Systems

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

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1971	(2002; Reprint Oct 2008) Signaling Devices for the Hearing Impaired

UL 268	(2009) Smoke Detectors for Fire Alarm Systems
UL 268A	(2008; Reprint Oct 2014) Smoke Detectors for Duct Application
UL 38	(2008; Reprint Nov 2013) Manual Signaling Boxes for Fire Alarm Systems
UL 464	(2009; Reprint Apr 2012) Standard for Audible Signal Appliances
UL 521	(1999; Reprint May 2010) Heat Detectors for Fire Protective Signaling Systems
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel
UL 864	(2003; Reprint Aug 2012) Standard for Control Units and Accessories for Fire Alarm Systems

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

Detail Drawings

SD-03 Product Data

Storage Batteries
Low Battery Voltage
Special Tools and Spare Parts
Technical Data and Computer Software;
Training
Testing

SD-06 Test Reports

Testing

SD-07 Certificates

Equipment
Qualifications

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions;

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

Submit proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

1.3.1.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.1.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 3 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.1.3 Fire Protection Engineer

Installations needing designs or modifications of fire detection, fire alarm, or fire suppression systems require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.

b. A registered professional engineer (P.E.) in fire protection engineering.

c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.

d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.3.2 Detail Drawings

Submit detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical audible appliances. Check the layout based on the actual audible devices to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detail drawings and detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

1.4 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

a. Identification of programmable portions of system equipment and capabilities.

b. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

c. Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

d. Description of Fire Alarm Control Panel equipment operation.

e. Description of auxiliary and remote equipment operations.

f. Library of application software.

g. Operation and maintenance manuals as specified in SD-19 of the Submittals paragraph.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

1.6 SPECIAL TOOLS AND SPARE PARTS

Submit spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with

the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service. Furnish software, connecting cables, proprietary equipment and two spare fuses of each type and size required, necessary for the maintenance, testing, and reprogramming of the equipment. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Mount spare fuses in the fire alarm panel.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

The fire detection and alarm system and the central reporting system shall be a complete, supervised fire alarm reporting system configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. Furnish equipment compatible and UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards. Locks shall be keyed alike. Provide four keys for the system. Furnish tags with stamped identification number for keys and locks.

2.1.1 Operation

Activate the system into the alarm mode by actuation of any alarm initiating device. The system will remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm and supervisory initiating devices shall be individually addressable. Alarm initiating devices shall be connected to signal line circuits (SLC), Class B, in accordance with NFPA 72. Connect alarm notification appliances to notification appliance circuits (NAC), Class B in accordance with NFPA 72. Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

a. Sufficient memory to perform as specified and as shown for addressable system.

b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors.

c. Capability of each addressable device being individually disabled or enabled from the panel.

d. Size each SLC to provide 40 percent addressable expansion without hardware modifications to the panel.

2.1.2 Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of IDC, SLC, and NAC.

b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within

the control panel, and transmitter tripping circuit integrity.

c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. Submit Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.

e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.

f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD displays on the control panel nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.

g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.

i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.

j. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.

k. The fire alarm control panel shall monitor the fire sprinkler system, or other fire protection extinguishing system.

l. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of

hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

n. Zones for IDC and NAC shall be arranged as indicated on the contract drawings.

2.1.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of signals over the station radio fire reporting system. The signals shall be as per drawings and base requirements.

b. Visual indications of the alarmed devices on the fire alarm control panel display.

c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ASA S3.41.

d. Closure of doors held open by electromagnetic devices.

e. Operation of the smoke control system.

f. Deactivation of the air handling units throughout the building.

2.1.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

2.1.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

2.1.6 Interface With Existing Fire Alarm Equipment

The equipment specified herein shall operate as an extension to an existing configuration. Submit certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards. The new equipment shall be connected to existing monitoring equipment at the Supervising Station. New components shall be capable of merging with the existing configuration without degrading the performance of either system. The scope of the acceptance tests of paragraph Testing shall include aspects of operation that involve combined use of both new and existing portions of the final configuration.

2.1.7 Interface With other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as

supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

2.2 STANDARD PRODUCTS

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

2.3 NAMEPLATES

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

2.4 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches.

a. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system.

b. Each IDC shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other devices. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

c. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

2.4.1 Remote System Audible/Visual Display

Audible appliance shall have a minimum sound level output rating of 85 dBA

at 10 feet and operate in conjunction with the panel integral display. The audible device shall be silenced by a system silence switch on the remote system. The audible device shall be silenced by the system silence switch located at the remote location, but shall not extinguish the visual indication. The remote LED/LCD visual display shall provide identification, consisting of the word description and id number for each device as displayed on the control panel. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Remote Display" shall be provided at the remote audible/visual display. The remote visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared.

2.4.2 Circuit Connections

Connect circuit conductors entering or leaving the panel to screw-type terminals with each conductor and terminal marked for identification.

2.4.3 System Expansion and Modification Capabilities

Provide, as part of this contract, any equipment and software needed by qualified technicians to implement future changes to the fire alarm system.

2.4.4 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Class B notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled.

2.4.5 Addressable Initiating Device Circuits Module

Configure the initiating device being monitored as a Class B initiating device circuits. The system shall be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED.

2.5 STORAGE BATTERIES

Submit substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included. Provide storage batteries which are 24 Vdc sealed, lead-calcium type requiring no additional water with ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours.

Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Locate batteries in a separate battery cabinet. Provide batteries with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Paint the cabinets to match the fire alarm control panel.

2.6 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Locate charger in control panel cabinet or in a separate battery cabinet.

2.7 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on semi-flush mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

2.8 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated. Installed devices shall conform to NFPA 70 hazard classification of the area where devices are to be installed.

2.8.1 Smoke Detectors

Design smoke detectors for detection of abnormal smoke densities. Smoke detectors shall be ionization type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be

provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.8.1.1 Ionization Detectors

Ionization detectors with a dual chamber shall be responsive to both invisible and visible particles of combustion. One chamber shall be a reference chamber and the second a sampling chamber. Detectors containing radium shall not be provided. Detectors shall not cause an alarm condition due to anticipated fluctuations in relative humidity. The sensitivity of the detector shall be field adjustable to compensate for operating conditions. Detector shall require no replacement or readjustment to restore it to normal operation after an alarm condition. Each detector shall be capable of withstanding ambient air velocity up to 300 fpm in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.8.1.2 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 23 09 23 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER LOCAL BUILDING SYSTEMS. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.9 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red. Recessed audible appliances shall be installed with a grill that is painted red.

2.9.1 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 10 feet. Horns used in exterior locations shall be specifically listed or approved for

outdoor use and be provided with metal housing and protective grilles.

2.9.2 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be semi-flush mounted.

2.9.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.10 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.10.1 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.10.2 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 16 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

2.11 TRANSMITTERS

2.11.1 Radio Alarm Transmitters

Transmitters shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of NFPA 72, NFPA 1221, and 47 CFR 15. Transmitter electronics module shall be contained within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is Monaco and the transceiver shall be fully compatible with this equipment. At the Contractors option, and if UL listed, the transmitter may be housed in the same panel as the fire alarm control panel.

2.11.1.1 Transmitter Power Supply

Each radio alarm transmitter shall be powered by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

2.11.1.1.1 Operation

Each transmitter shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic. Each transmitter shall meet the following requirements: Monaco BT-X.

2.11.1.1.2 Battery Power

Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.11.1.2 Radio Alarm Transmitter Housing

Transmitter housing shall be NEMA Type 1. The housing shall contain a lock that is keyed identical to radio alarm transmitter housings on the base. Radio alarm transmitter housing shall be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

2.11.1.3 Antenna

Provide omnidirectional, coaxial, halfwave dipole antennas for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 100 mph. Antennas shall not be mounted to any portion of the building roofing system.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Install all work as shown, in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.2.1 Power Supply for the System

Provide a single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT

CONTROL".

3.2.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.2.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. Manually operable controls shall be between 36 and 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.2.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

3.2.5 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

3.2.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

3.2.7 Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to

or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in Section 21 13 13.00 10 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION NFPA 72, as indicated on the drawings and as specified herein.

3.2.8 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall he mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in Section 21 13 13.00 10 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION NFPA 72, as indicated on the drawings and as specified herein.

3.3 OVERVOLTAGE AND SURGE PROTECTION

3.3.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.3.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges in accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.3.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges in

accordance with IEEE C62.41.1/IEEE C62.41.2 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

3.4 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.5 SUPERVISING STATION PROVISIONS

The supervising equipment is existing and consists of the following brands and models: Monaco.

3.6 TRAINING

Submit lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. Conduct the course in the building where the system is installed or as designated by the Contracting Officer.

a. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

b. The maintenance training course shall provide the designated Government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system. Provide training course for the maintenance staff. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

c. The training period for systems operation shall consist of 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.

3.7 TESTING

Notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. Perform the tests in accordance with the approved test procedures in the presence of the Contracting Officer.

The control panel manufacturer's representative shall be present to supervise tests. Furnish instruments and personnel required for the tests.

a. Submit detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

b. Submit test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. Include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

3.7.1 Preliminary Tests

Upon completion of the installation, subject the system to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. Conduct the megger test prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing complete and submit the NFPA 72, Certificate of Completion and Testing Form.

3.7.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Conduct testing in accordance with NFPA 72. The recommended tests in NFPA 72 are considered mandatory and shall verify that previous deficiencies have been corrected. The Fire alarm Technician supervising the installation of the fire alarm system shall attend the testing of the system. The test shall include all requirements of NFPA 72 and the following:

a. Test of each function of the control panel.

b. Test of each circuit in both trouble and normal modes.

c. Tests of each alarm initiating devices in both normal and trouble conditions.

d. Tests of each control circuit and device.

e. Tests of each alarm notification appliance.

f. Tests of the battery charger and batteries.

g. Complete operational tests under emergency power supply.

h. Visual inspection of wiring connections.

i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.

j. Ground fault.

k. Short circuit faults.

l. Stray voltage.

m. Loop resistance.

-- End of Section --

SECTION 31 00 00

EARTHWORK
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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2009) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
AASHTO T 224	(2001; R 2004) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM D 1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2487	(2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 698	(2007e1) 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 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SP-SM, . Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements and railroads which comprise stones less than 3 inches in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.2.5 Topsoil

Material suitable for topsoils obtained from offsite areas is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.2.6 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.

1.2.7 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.

1.2.8 Unstable Material

Unstable material are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.9 Select Granular Material

1.2.9.1 General Requirements

Select granular material consist of materials classified as SP by ASTM D 2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D 1140.

1.2.10 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 than 2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.2.11 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 SYSTEM DESCRIPTION

Subsurface soil boring logs are shown on the drawings . These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.3.1 Classification of Excavation

1.3.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.3.1.2 Rock Excavation

Include rock excavation with blasting, excavating, grading, disposing of material classified as rock, and the satisfactory removal and disposal of boulders 1/2 cubic yard or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling and blasting; firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling and blasting; and hard materials (see Definitions). Include the removal of any concrete or masonry structures, except pavements, exceeding 1/2 cubic yard in volume that may be encountered in the work in this classification. If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, uncover such material and notify the Contracting Officer. Do not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to uncover such material, notify the Contracting Officer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

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

Testing

Within 24 hours of conclusion of physical tests, 4 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing

Qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities.

PART 2 PRODUCTS

2.1 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.1.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.1.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.2 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.3 MATERIAL FOR RIP-RAP

2.3.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inch. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.

2.3.2 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Provide rock with a minimum specific gravity of 2.50 . Do not permit the inclusion of more than trace 1 percent quantities of dirt, sand, clay, and rock fines.

2.4 CAPILLARY WATER BARRIER

Provide capillary water barrier of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or

without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Conform to ASTM C 33/C 33M for fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or or coarse aggregate Size 57, 67, or 77.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inch. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inch in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 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 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 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be

installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than 4 feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls more than 4 feet high. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inch inside diameter, and do not exceed 36 inch plus pipe outside diameter for sizes larger than 24 inch inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.2.2.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 3 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.2.2 Removal of Unyielding Material

Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, remove such material 4 inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.2.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.2.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least 12 inch clear between the outer structure surfaces and the face of the excavation or support members Clean rock of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.3 Underground Utilities

The Contractor is responsible for movement of construction machinery and

equipment over pipes and utilities during construction. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.4 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 SHORING

3.4.1 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary.

3.5 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.6 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond.

3.7 GROUND SURFACE PREPARATION

3.7.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inch before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inch, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inch and compact it as specified for the adjacent fill.

3.7.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.8 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.9 BURIED TAPE AND DETECTION WIRE

3.9.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inch below finished grade; under pavements and slabs, bury tape 6 inch below top of subgrade.

3.9.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inch above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over it's entire length. Install wires at manholes between the top of the

corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.10 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed as specified in paragraph GROUND SURFACE PREPARATION. Provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.10.1 Trench Backfill

Backfill trenches to the grade shown. Do not backfill the trench until all specified tests are performed.

3.10.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

3.10.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inch loose thickness.

3.10.1.3 Bedding and Initial Backfill

Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D 698 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

a. Class I: Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

c. Clean, coarse-grained sand classified in accordance with Section 31 00 00 EARTHWORK.

3.10.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

a. Roadways, Railroads, and Airfields: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Deposit backfill in layers of a maximum of 12 inch loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils.

3.10.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.11 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.11.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 18 inch of cover in rock excavation and a minimum 24 inch of cover in other excavation.

3.11.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 2.5 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional 6 inch of cover is required.

3.11.3 Heat Distribution System

Free initial backfill material of stones larger than 1/4 inch in any dimension.

3.11.4 Electrical Distribution System

Provide a minimum cover of 24 inch from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.11.5 Rip-Rap Construction

Construct rip-rap on filter fabric in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.11.5.1 Bedding Placement

Spread bedding material uniformly to a thickness of at least 3 inch on prepared subgrade as indicated. Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.

3.11.5.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.12 SUBGRADE PREPARATION

3.12.1 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inch below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, do not show deviations for the surface of the subgrade for roadways greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.12.2 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 90 percent of laboratory maximum density.

3.12.2.1 Subgrade for Pavements

Compact subgrade for pavements to at least 98 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 12 inch of subgrade.

3.12.2.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 95 percentage laboratory maximum density for the full depth of the shoulder.

3.12.2.3 Subgrade for Airfield Pavements

Compact top 24 inch below finished pavement or top 12 inch of subgrades, whichever is greater, to 100 percent of ASTM D 1557; compact fill and backfill material to 100 percent of ASTM D 1557.

3.13 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.14 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.14.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do no disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.14.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.14.3 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.15 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inch depth for bonding of topsoil with subsoil. Spread topsoil evenly to a

thickness of 4 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas .

3.16 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer. Determine field in-place density in accordance with ASTM D 1556 . When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.16.1 Fill and Backfill Material Gradation

One test per 5000 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C 136 .

3.16.2 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 1000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 200 linear feet, or fraction thereof, of each lift of embankment or backfill for roads and airfields.

3.16.3 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.

3.16.4 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 5000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.16.5 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph

SUBGRADE PREPARATION during construction of the subgrades.

3.16.6 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe , inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 36 inch, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.17 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 --

SECTION 31 11 00

CLEARING AND GRUBBING
08/08

PART 1 GENERAL

1.1 DELIVERY, STORAGE, AND HANDLING

Deliver materials to store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the Contracting Officer in ample time to minimize interruption of the service. Refer to Section 01300, ADMINISTRATIVE REQUIREMENTS and Section 01500, TEMPORARY FACILITIES AND CONTROLS for additional utility protection.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly

cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 PRUNING

Trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 DISPOSAL OF MATERIALS

3.6.1 Saleable Timber

1. All timber on the project site noted for clearing and grubbing shall become the property of the Contractor, and shall be removed from the project site and disposed of off stations.

3.6.2 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

-- End of Section --

SECTION 31 31 16.13

CHEMICAL TERMITE CONTROL
11/14

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.

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 4150.07 DOD Pest Management Program

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.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Termiticide Application Plan; G[, [_____]]
Termiticides
Foundation Exterior
Utilities and Vents
Crawl and Plenum Air Spaces
Verification of Measurement
Application Equipment
Warranty

SD-04 Samples

Termiticides

SD-06 Test Reports

Equipment Calibration and Tank Measurement
Soil Moisture
Quality Assurance

SD-07 Certificates

Qualifications

1.3 QUALITY ASSURANCE

Comply with DODI 4150.07 for requirements on Contractor's licensing, certification, and record keeping. Maintain daily records using the Pest

Management Maintenance Record, DD Form 1532-1, or a computer generated equivalent, and submit copies of records when requested by the Contracting Officer. These forms may be obtained from the main web site:

Upon completion of this work, submit the Pest Management Report DD Form 1532, or an equivalent computer product, to the Integrated Pest Management Coordinator. This form identifies the target pest, type of operation, brand name and manufacturer of pesticide, formulation, concentration or rate of application used.

1.3.1 Qualifications

For the application of pesticides, use the services of a applicator whose principal business is pest control. The applicator shall be licensed and certified in the state where the work is to be performed. Termiticide applicators shall also be certified in the U.S. Environmental Protection Agency (EPA) pesticide applicator category which includes structural pest control. Submit a copy of the pest control business license and pesticide applicator certificate(s).

[The contractor shall:

a. Have personnel with a commercial state of North Carolina certification as required by DODI 4150.07.

b. Provide a submittal with the following information to the Contracting Officer and installation Integrated Pest Management Coordinator:

(1) Quantity of pesticide used.
(2) Rate of dispersion.
(3) Percent of use.
(4) Total amount used.]

1.3.2 Safety Requirements

Formulate, treat, and dispose of termiticides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Contracting Officer, and fit the filling hose with a backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of a contractor's representative to prevent overflow. Secure pesticides and related materials under lock and key when unattended. Ensure that proper protective clothing and equipment are worn and used during all phases of termiticide application. Dispose of used pesticide containers off Government property.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Deliver termiticide material to the site in the original unopened containers bearing legible labels indicating the EPA registration number and manufacturer's registered uses. All other materials, to be used on site for the purpose of termite control, shall be delivered in new or

otherwise good condition as supplied by the manufacturer or formulator.

1.4.2 Inspection

Inspect termiticides upon arrival at the job site for conformity to type and quality in accordance with paragraph TERMITICIDES. Each label shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended or under appropriate regulations of the host county. Other materials shall be inspected for conformance with specified requirements. Remove unacceptable materials from the job site.

1.4.3 Storage

Contractors shall not store pesticides on the installation unless it is written into the contract.

1.4.4 Handling

Termiticides shall be handled and mixed in accordance with the manufacturer's label and SDS, preventing contamination by dirt, water, and organic material. Protect termiticides from weather elements as recommended by the manufacturer's label and SDS. Spill kits must be maintained on pest control vehicles and must be available at the mixing site. Termiticide mixing must be conducted in an area with adequate spill containment..

1.5 SITE CONDITIONS

The following conditions will determine the time of application.

1.5.1 Soil Moisture

Soils to be treated shall be tested immediately before application. Test soil moisture content to a minimum depth of 3 inches. The soil moisture shall be as recommended by the termiticide manufacturer. The termiticide will not be applied when soil moisture exceeds manufacturer's recommendations because termiticides do not adhere to the soil particles in saturated soils.

1.5.2 Runoff and Wind Drift

Do not apply termiticide during or immediately following heavy rains. Applications shall not be performed when conditions may cause runoff or create an environmental hazard. Applications shall not be performed when average wind speed exceeds 10 miles per hour. The termiticide shall not be allowed to enter water systems, aquifers, or endanger humans or animals.

1.5.2.1 Vapor Barriers and Waterproof Membranes

Termiticide shall be applied prior to placement of a vapor barrier or waterproof membrane.

1.5.2.2 Utilities and Vents

Prior to application, HVAC ducts and vents located in treatment area shall be turned off and blocked to protect people and animals from termiticide. Submit written verification that utilities and vents have been located and treated as specified.

1.5.3 Placement of Concrete

Place concrete covering treated soils as soon as the termiticide has reached maximum penetration into the soil. Time for maximum penetration shall be as recommended by the manufacturer.

1.6 WARRANTY

The Contractor shall provide a 5 -year written warranty against infestations or reinfestations by subterranean termites of the buildings or building additions constructed under this contract. Warranty shall include annual inspections of the buildings or building additions. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim:

a. Retreat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;

b. Repair damage caused by termite infestation; and

c. Reinspect the building approximately 180 days after the retreatment.

PART 2 PRODUCTS

2.1 TERMITICIDES

Submit manufacturer's label and Material Safety Data Sheet (MSDS) for termiticides proposed for use. Provide termiticides currently registered by the EPA or approved for such use by the appropriate agency of the host county. Non-repellant termiticides shall be selected for maximum effectiveness and duration after application. The selected termiticide shall be suitable for the soil and climatic conditions at the project site and applied at the highest labeled rate. Submit samples of the pesticides used in this work. The Contracting Officer may draw, at any time and without prior notice, from stocks at the job site; should analysis, performed by the Government, indicate such samples to contain less than the amount of active ingredient specified on the label, work performed with such products shall be repeated, with pesticides conforming to this specification, at no additional cost to the Government.

PART 3 EXECUTION

3.1 VERIFICATION OF MEASUREMENT

Once termiticide application has been completed, measure tank contents to determine the remaining volume. The total volume measurement of used contents for the application shall equal the established application rate for the project site conditions. Provide written verification that the volume of termiticide used meets the application rate.

3.2 TECHNICAL REPRESENTATIVE

A DOD certified pesticide applicator or Pest Management Quality Assurance Evaluator (QAE)/Performance Assessment Representative (PAR) shall be the technical representative, shall be present at all meetings concerning treatment measures for subterranean termites, and shall be present during treatment application. The command Integrated Pest Management Coordinator shall be contacted prior to starting work.

3.3 SITE PREPARATION

Work related to final grades, landscape plantings, foundations, or any other alterations to finished construction which might alter the condition of treated soils, must be coordinated with this specification.

3.3.1 Ground Preparation

Eliminate food sources by removing debris from clearing and grubbing and post construction wood scraps such as ground stakes, form boards, and scrap lumber from the site, before termiticide application begins.

3.3.2 Verification

Before work starts, verify that final grades are as indicated and smooth grading has been completed in accordance with Section 31 00 00 EARTHWORK. Soil particles shall be finely graded with particles no larger than 1 inch and compacted to eliminate soil movement to the greatest degree.

3.3.3 Foundation Exterior

Provide written verification that final grading and landscape planting operations will not disturb treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures.

3.3.4 Utilities and Vents

Provide written verification that the location and identity of HVAC ducts and vents, water and sewer lines, and plumbing have been accomplished prior to the termiticide application.

3.3.5 Crawl and Plenum Air Spaces

Provide written verification that the location and identity of crawl and plenum air spaces have been accomplished prior to the termiticide application.

3.3.6 Application Plan

Submit a Termiticide Application Plan with proposed sequence of treatment work with dates and times for approval before starting the specified treatment. Include the termiticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area/volume treated, and amount applied. Also include a copy of the pest control business license and pesticide applicator certificate(s).

3.4 TERMITICIDE TREATMENT

3.4.1 Equipment Calibration and Tank Measurement

Submit a listing of equipment to be used. Immediately prior to commencement of termiticide application, calibration tests shall be conducted on the application equipment to be used and the application tank shall be measured to determine the volume and contents. These tests shall confirm that the application equipment is operating within the manufacturer's specifications and will meet the specified requirements. Submit written certification of the equipment calibration test results

within 1 week of testing.

3.4.2 Mixing and Application

Formulating, mixing, and application shall be performed in the presence of a DOD certified pesticide applicator, Pest Management QAE/PAR, or Integrated Pest Management Coordinator. A closed system is recommended as it prevents the termiticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Spill kits must be maintained on pest control vehicles and must be available at the mixing site. Termiticide mixing must be conducted in an area that has been designated by the government representative and that has adequate spill containment. Prior to each day of use, the equipment used for applying termiticides shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.4.3 Treatment Method

For areas to be treated, establish complete and unbroken vertical and/or horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Applications to crawl spaces shall be made in accordance with (IAW) label directions. Applications shall not be made to crawl space areas that are used as plenum air spaces.

3.4.3.1 Surface Application

Use surface application for establishing horizontal barriers. Surface applicants shall be applied as a coarse spray and provide uniform distribution over the soil surface. Termiticide shall penetrate a minimum of 1 inch into the soil, or as recommended by the manufacturer.

3.4.3.2 Rodding and Trenching

Use rodding and trenching for establishing vertical soil barriers. Trenching shall be to the depth of the foundation footing. Width of trench shall be as recommended by the manufacturer, or as indicated. Rodding or other approved method may be implemented for saturating the base of the trench with termiticide. Immediately after termiticide has reached maximum penetration as recommended by the manufacturer, backfilling of the trench shall commence. Backfilling shall be in 6 inch rises or layers. Each rise shall be treated with termiticide.

3.4.4 Sampling

The Contracting Officer may draw from stocks at the job site, at any time and without prior notice, take samples of the termiticides used to determine if the amount of active ingredient specified on the label is being applied.

3.5 CLEAN UP, DISPOSAL, AND PROTECTION

Once application has been completed, proceed with clean up and protection of the site without delay.

3.5.1 Clean Up

The site shall be cleaned of all material associated with the treatment measures, according to label instructions, and as indicated. Excess and waste material shall be removed and disposed off site.

3.5.2 Disposal of Termiticide

Dispose of residual termiticides and containers off Government property, and in accordance with label instructions and EPA criteria.

3.5.3 Protection of Treated Area

Immediately after the application, the area shall be protected from other use by erecting barricades and providing signage as required or directed. Signage shall be in accordance with Section 10 14 01 EXTERIOR SIGNAGE. Signage shall be placed inside the entrances to crawl spaces and shall identify the space as treated with termiticide and not safe for children and animals. Treated areas should be covered with plastic if slab is not to be poured immediately following termiticide application.

3.6 CONDITIONS FOR SATISFACTORY TREATMENT

3.6.1 Equipment Calibrations and Measurements

Where results from the equipment calibration and tank measurements tests are unsatisfactory, re-treatment will be required.

3.6.2 Testing

Should an analysis, performed by a third party, indicate that the samples of the applied termiticide contain less than the amount of active ingredient specified on the label, and/or if soils are treated to a depth less than specified or approved, re-treatment will be required.

3.6.3 Disturbance of Treated Soils

Soil and fill material disturbed after treatment shall be re-treated before placement of slabs or other covering structures.

3.6.4 Termites Found Within the Warranty Period

If live subterranean termite infestation or termite damage is discovered during the warranty period, re-treat the site.

3.7 RE-TREATMENT

Where re-treatment is required, comply with the requirements specified in paragraph WARRANTY.

-- 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	(2009) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
AASHTO T 224	(2001; R 2004) Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2487	(2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM E 11	(2009) Wire Cloth and Sieves for Testing Purposes

MISSISSIPPI DEPARTMENT OF TRANSPORTATION (MDOT)

MDOT Std Specs	(2004) Standard Specifications for Road and Bridge Construction

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 D 1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, 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 SYSTEM DESCRIPTION

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. Provide adequate equipment having the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth 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. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Field Density Tests

Copies of field test results within 48 hours after the tests are performed.

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor and performed by a testing laboratory approved in accordance with Section 01400 QUALITY REQUIREMENTS. 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.

1.5.1 Sampling

Take samples for laboratory testing in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

Perform the following tests in conformance with the applicable standards listed.

1.5.2.1 Sieve Analysis

Make sieve analysis in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11. Particle-size analysis of the soils shall also be completed in conformance with ASTM D 422.

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D 4318.

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with ASTM D 1557 .

1.5.2.4 Field Density Tests

Aggregate shall be compacted to a minimum of 96 percent of a maximum dry density as defined by ASTM D 698.

1.5.3 Testing Frequency

1.5.3.1 In Place Tests

Perform one (1) density test for every 10,000 square feet of prepared aggregate base/subbase. At a minimum one (1) test shall be performed.

PART 2 PRODUCTS

2.1 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 D 2487, 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.

2.1.1 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 shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.

2.1.1.1 Graded-Crushed Aggregate

Crushed limestone shall meet the MDOT Std Specs for Size 610 aggregate.

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 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.

3.3 PREPARATION OF UNDERLYING COURSE

The subgrade shall be processed in-situ soils or select imported fill compacted to a minimum of 95 percent maximum dry density as defined by ASTM D 698.

3.4 INSTALLATION

3.4.1 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.

3.4.2 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.

3.4.3 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.

3.4.4 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 paragraph SAMPLING AND TESTING. 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 96 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.

3.4.5 Thickness

Aggregate thickness shall be per the pavement section shown on the Civil drawings.

-- End of Section --

SECTION 32 13 13.06

PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES
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 CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 301	(2010) Specifications for Structural Concrete
ACI 305R	(2010) Specification for Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C215	(2010) Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines

ASTM INTERNATIONAL (ASTM)

ASTM A184/A184M	(2006) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615/A615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A966/A966M	(2008) Standard Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current
ASTM C1077	(2011c) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C143/C143M	(2010a) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C494/C494M	(2011) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C94/C94M	(2011b) Standard Specification for Ready-Mixed Concrete
ASTM C989	(2010) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2010) 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 C78/C78M	(2010) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM D6270	(2008e1) Use of Scrap Tires in Civil Engineering Applications

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

SD-03 Product Data

Curing materials; G, RO

Admixtures; G, RO

Dowel; G, RO

Reinforcement; G, RO

Submit a complete list of materials including type, brand and applicable reference specifications.

Cementitious Materials; G, RO

Aggregate; G, RO

SD-05 Design Data

Concrete mix design; G, RO

Thirty days minimum prior to concrete placement, submit a mix design, with applicable tests, for each strength and type of concrete for approval. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, slag, and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Obtain acknowledgement of approvals prior to concrete placement. Submit a new mix design for each material source change.

SD-06 Test Reports

Aggregate tests; G, RO

Concrete slump tests; G, RO

Air content tests; G, RO

Flexural strength tests; G, RO

Cementitious materials; G, RO

SD-07 Certificates

Ready-mixed concrete plant; G, RO

Batch tickets; G, RO

Cementitious materials; G, RO

1.3 DELIVERY, STORAGE, AND HANDLING

ASTM C94/C94M.

1.4 QUALITY ASSURANCE

1.4.1 Ready-mixed Concrete Plant Certification

Provide documentation that the ready-mix plant is certified by the National Ready-Mix Concrete Association (NRMCA).

1.4.2 Required Information

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cementitious materials, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with the concrete mix design. Sampling and testing of materials, concrete mix design, sampling and testing in the field shall be performed by a commercial testing laboratory which conforms to ASTM C1077. The laboratory shall be approved in writing by the Government.

1.4.3 Batch Tickets

ASTM C94/C94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials in concrete mix shall be 50 percent non-portland cement pozzolanic materials by weight. Provide test data demonstrating compatibility and performance of concrete satisfactory to Contracting Officer's Representative.

2.1.1.1 Cement

ASTM C150/C150M, Type I or II with maximum alkali content of 0.60 percent. Cement certificate shall include test results in accordance with ASTM C150/C150M, including equivalent alkalies indicated in the Supplementary Optional Chemical Requirements.

2.1.1.2 Fly Ash and Pozzolan

ASTM C618, Type F, except that the maximum allowable loss on ignition shall be 6 percent, maximum available alkalies content shall be 1.5 percent, and maximum calcium oxide (CaO) content 8 percent. Fly ash certificates shall include test results in accordance with ASTM C 618, including available alkalies indicated in the Supplementary Optional Chemical Requirements.

2.1.1.3 Slag

ASTM C989, Ground Granulated Blast Furnace Slag (GGBFS), Grade 100 or 120. Certificates shall include test results in accordance with ASTM C989.

2.1.2 Water

ASTM C94/C94M, fresh, clean, and potable.

2.1.3 Aggregate

2.1.3.1 Alkali Reactivity Test

Aggregates to be used in all concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C1260. The types of aggregates shall be evaluated in a combination which matches the contractors' proposed mix design (including Class F fly ash or GGBF slag), utilizing the modified version of ASTM C1260. Test results of the combination shall have a measured expansion of less than 0.08 percent at 16 days. Should the test data indicate an expansion of greater than 0.08 percent, the aggregate(s) shall be rejected and the contractor shall submit new aggregate sources for retesting or may submit additional test results incorporating Lithium Nitrate for consideration.

ASTM C1260 shall be modified as follows to include one of the following options:

a. Utilize the contractor's proposed low alkali Portland cement and Class F fly ash in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement and fly ash.

b. Utilize the contractor's proposed low alkali Portland cement and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement and GGBF.

c. Utilize the contractor's proposed low alkali Portland cement and Class F fly ash and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement, fly ash and GGBF.

2.1.3.2 Fine Aggregates

ASTM C33/C33M.

2.1.3.3 Coarse Aggregates

ASTM C33/C33M.

2.1.3.4 Tire Aggregate

Comply with ASTM D6270.

2.1.4 Admixtures

ASTM C494/C494M: 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. Where not shown or specified, the use of admixtures is subject to written approval of the Contracting Officer's Representative.

ASTM C260/C260M: Air-entraining.

2.1.5 Reinforcement

2.1.5.1 Dowel Bars

Bars shall conform to ASTM A615/A615M, for plain billet-steel bars of the size and length indicated. Remove all burrs and projections from the bars.

2.1.5.2 Coated Dowel Bars

Bars shall conform to ASTM A615/A615M, for plain billet-steel bars of the size and length indicated. Remove all burrs or projections from the dowel bars. Coating system shall conform to AWWA C215, Type 2. Coat the bars with a double coat system or an epoxy coating system for resistance to penetration of oil and salt solutions. The systems shall be in accordance with manufacturer's recommendation for coatings which are not bondable to concrete. Bond the coating to the dowel bar to resist laps or folds during movement of the joint. Coating thickness shall be 7 mils minimum and 20 mils maximum.

2.1.5.3 Tie Bars

Bars shall be billet or axle steel deformed bars and conform to ASTM A615/A615M or ASTM A966/A966M. Epoxy coated in accordance with ASTM A775/A775M.

2.1.5.4 Reinforcement

Deformed steel bar mats shall conform to ASTM A184/A184M. Bar reinforcement shall conform to ASTM A615/A615M.

2.1.6 Curing Materials

2.1.6.1 White-Burlap-Polyethylene Sheet

ASTM C171, 0.004 inch thick white opaque polyethylene bonded to 10 oz/linear yard (40 inch) wide burlap.

2.1.6.2 Liquid Membrane-Forming Compound

ASTM C309, white pigmented, Type 2, Class B, free of paraffin or petroleum.

2.1.6.3 Liquid Chemical Sealer-Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Compound shall not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.2 CONTRACTOR-FURNISHED MIX DESIGN

Contractor-furnished mix design concrete shall be designed in accordance with ACI 211.1 except as modified herein, and the mix design shall be as specified herein under paragraph entitled "Submittals." The concrete shall have a minimum flexural strength of 650 pounds per square inch at 90 days. The concrete may be air entrained. If air entrainment is used the air content shall be 5.0 plus or minus 1.5 percent. Maximum size aggregate for slip forming shall be 1.5 inches. The minimum cementitious factor is 564 lbs per cubic yard and slump shall be 1 to 3 inches (or less when slip form

is used.

If the cementitious material is not sufficient to produce concrete of the flexural strength required it shall be increased as necessary, without additional compensation under the contract. The cementitious factor shall be calculated using cement, Class F fly ash, and or GGBF slag. The mix shall use a cement replacement (by weight) of 25 percent - 35 percent Class F fly ash, or 40 percent - 50 percent GGBF slag, or a combination of the two. In the combination, each 5 percent of Class F fly ash shall be replaced by 8 percent GGBF slag.

PART 3 EXECUTION

3.1 FORMS

3.1.1 Construction

Construct forms to be removable without damaging the concrete.

3.1.2 Coating

Before placing the concrete, coat the contact surfaces of forms with a non-staining mineral oil, non-staining form coating compound, or two coats of nitro-cellulose lacquer.

3.1.3 Grade and Alignment

Check and correct grade elevations and alignment of the forms immediately before placing the concrete.

3.2 REINFORCEMENT

3.2.1 Dowel Bars

Install bars accurately aligned, vertically and horizontally, at indicated locations and to the dimensions and tolerances indicated. Before installation thoroughly grease the sliding portion of each dowel. Dowels must remain in position during concrete placement and curing.

3.2.2 Coated Dowel Bars

Install bars, accurately aligned vertically and horizontally, at indicated locations and to the dimensions and tolerances indicated. Reject coatings which are perforated, cracked or otherwise damaged. While handling avoid scuffing or gouging of the coatings.

3.2.3 Tie Bars

Install bars, accurately aligned horizontally and vertically, at indicated locations. For slipform construction, insert bent tie bars by hand or other approved means.

3.2.4 Setting Slab Reinforcement

Reinforcement shall be positioned on suitable chairs prior to concrete placement. At expansion, contraction and construction joints, place the reinforcement as indicated. Reinforcement, when placed in concrete, shall be free of mud, oil, scale or other foreign materials. Place reinforcement accurately and wire securely. The laps at splices shall be 12 inches

minimum and the distances from ends and sides of slabs and joints shall be as indicated.

3.3 MEASURING, MIXING, CONVEYING, AND PLACING CONCRETE

3.3.1 Measuring

ASTM C94/C94M.

3.3.2 Mixing

ASTM C94/C94M, except as modified herein. Begin mixing within 30 minutes after cement has been added to aggregates. When the air temperature is greater than 85 degrees F, reduce mixing time and place concrete within 60 minutes. Additional water may be added to bring slump within required limits as specified in Section 11.7 of ASTM C94/C94M, provided that the specified water-cement ratio is not exceeded.

3.3.3 Conveying

ASTM C94/C94M.

3.3.4 Placing

Follow guidance of ACI 301, except as modified herein. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete continuously at a uniform rate, with minimum amount of segregation, without damage to the grade and without unscheduled stops except for equipment failure or other emergencies. If this occurs within 10 feet of a previously placed expansion joint, remove concrete back to joint, repair any damage to grade, install a construction joint and continue placing concrete only after cause of the stop has been corrected.

3.3.5 Vibration

Immediately after spreading concrete, consolidate concrete with internal type vibrating equipment along the boundaries of all slabs regardless of slab thickness, and interior of all concrete slabs 6 inches or more in thickness. Limit duration of vibration to that necessary to produce consolidation of concrete. Excessive vibration will not be permitted. Vibrators shall not be operated in concrete at one location for more than 15 seconds. At the option of the Contractor, vibrating equipment of a type approved by the Contracting Officer's Representative may be used to consolidate concrete in unreinforced pavement slabs less than 6 inches thick.

3.3.5.1 Vibrating Equipment

Operate equipment, except hand-manipulated equipment, ahead of the finishing machine. Select the number of vibrating units and power of each unit to properly consolidate the concrete. Mount units on a frame that is capable of vertical movement and, when necessary, radial movement, so vibrators may be operated at any desired depth within the slab or be completely withdrawn from the concrete. Clear distance between frame-mounted vibrating units that have spuds that extend into the slab at intervals across the paving lane shall not exceed 30 inches.. Distance between end of vibrating tube and side form shall not exceed 2 inches. For pavements less than 10 inches thick, operate vibrators at mid-depth parallel with or at a slight angle to the subbase. For thicker pavements,

angle vibrators toward the vertical, with vibrator tip preferably about 2 inches from subbase, and top of vibrator a few inches below pavement surface. Vibrators may be pneumatic, gas driven, or electric, and shall be operated at frequencies within the concrete of not less than 8,000 vibrations per minute. Amplitude of vibration shall be such that noticeable vibrations occur at 1.5 foot radius when the vibrator is inserted in the concrete to the depth specified.

3.3.6 Cold Weather

Except with authorization, do not place concrete when ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. When authorized, when concrete is likely to be subjected to freezing within 24 hours after placing, heat concrete materials so that temperature of concrete when deposited is between 65 and 80 degrees F. Methods of heating materials are subject to approval of the Contracting Officer's Representative. Do not heat mixing water above 165 degrees F. Remove lumps of frozen material and ice from aggregates before placing aggregates in mixer. Follow practices found in ACI 306.1.

3.3.7 Hot Weather

Maintain required concrete temperature in accordance with Figure 2.1.5 in ACI 305R to prevent 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. After placement, use fog spray, apply monomolecular film, or use other suitable means to reduce the evaporation rate. Start curing when surface of fresh concrete is sufficiently hard to permit curing without damage. Cool underlying material by sprinkling lightly with water before placing concrete. Follow practices found in ACI 305R.

3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing fixed forms .

3.4.1 Consolidation

The paver vibrators shall be inserted into the concrete not closer to the underlying material than 2 inches. The vibrators or any tamping units in front of the paver shall be automatically controlled so that they shall be stopped immediately as forward motion ceases. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment shall be vibrated with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

3.4.2 Operation

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, including keeping the existing pavement surface free of any debris, and placing rubber mats beneath the paver tracks. Transversely oscillating screeds and extrusion plates shall overlap the existing pavement the minimum possible, but in no case more than 8 inches.

3.4.3 Required Results

The paver-finisher shall be operated 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. It shall produce only a very minimum of paste at the surface. Multiple passes of the paver-finisher shall 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. No water, other than true fog sprays (mist), shall be applied to the concrete surface during paving and finishing.

3.4.4 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less than eight-tenths of the vertical height of the form, except that forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

3.4.5 Placing Dowels and Tie Bars

Dowels shall be installed with alignment not greater than 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 5/8 inch and a vertical tolerance of plus or minus 3/16 inch. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels in joints shall be omitted when the center of the dowel is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.4.5.1 Contraction Joints

Dowels in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

3.4.5.2 Construction Joints-Fixed Form Paving

Installation of dowels shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

3.4.5.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the

hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin 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 shall 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 collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the dowel.

3.4.5.4 Expansion Joints

Dowels in expansion joints shall be installed by the bonded-in-place method or by bonding into holes drilled in hardened concrete, using procedures specified above.

3.5 FINISHING CONCRETE

Start finishing operations immediately after placement of concrete. Use finishing machine, except hand finishing may be used in emergencies and for concrete slabs in inaccessible locations or of such shapes or sizes that machine finishing is impracticable. Finish pavement surface on both sides of a joint to the same grade. Finish formed joints from a securely supported transverse bridge. Provide hand finishing equipment for use at all times. Transverse and longitudinal surface tolerances shall be 1/4 inch in 10 feet.

3.5.1 Side Form Finishing

Strike off and screed concrete to the required slope and cross-section by a power-driven transverse finishing machine. Transverse rotating tube or pipe shall not be permitted unless approved by the Contracting Officer's Representative. Elevation of concrete shall be such that, when consolidated and finished, pavement surface will be adequately consolidated and at the required grade. Equip finishing machine with two screeds which are readily and accurately adjustable for changes in pavement slope and compensation for wear and other causes. Make as many passes over each area of pavement and at such intervals as necessary to give proper compaction, retention of coarse aggregate near the finished surface, and a surface of uniform texture, true to grade and slope. Do not permit excessive operation over an area, which will result in an excess of mortar and water being brought to the surface.

3.5.1.1 Equipment Operation

Maintain the travel of machine on the forms without lifting, wobbling, or other variation of the machine which tend to affect the precision of concrete finish. Keep the tops of the forms clean by a device attached to the machine. During the first pass of the finishing machine, maintain a uniform ridge of concrete ahead of the front screed for its entire length.

3.5.1.2 Joint Finish

Before concrete is hardened, correct edge slump of pavement, exclusive of edge rounding, in excess of 0.02 foot. Finish concrete surface on each

side of construction joints to the same plane, and correct deviations before newly placed concrete has hardened.

3.5.1.3 Hand Finishing

Strike-off and screed surface of concrete to elevations slightly above finish grade so that when concrete is consolidated and finished pavement surface is at the indicated elevation. Vibrate entire surface until required compaction and reduction of surface voids is secured with a strike-off template.

3.5.1.4 Longitudinal Floating

After initial finishing, further smooth and consolidate concrete by means of hand-operated longitudinal floats. Use floats that are not less than 12 feet long and 6 inches wide and stiffened to prevent flexing and warping.

3.5.2 Texturing

Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein. Following initial texturing on the first day of placement, the Placing Foreman, Contracting Officer's Representative representative, and a representative of the Using Agency shall inspect the texturing for compliance with design requirements. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris. The concrete in areas of recesses for tie-down anchors, lighting fixtures, and other outlets in the pavement shall be finished to provide a surface of the same texture as the surrounding area.

3.5.2.1 Burlap Drag Finish

Before concrete becomes non-plastic, finish the surface of the slab by dragging on the surface a strip of clean, wet burlap measuring from 3 to 10 feet long and 2 feet wider than the width of the pavement. Select dimension of burlap drag so that at least 3 feet of the material is in contact with the pavement. Drag the surface so as to produce a finished surface with a fine granular or sandy texture without leaving disfiguring marks.

3.5.2.2 Brooming

Finish the surface of the slab by brooming the surface with a new wire broom at least 18 inches wide. Gently pull the broom over the surface of the pavement from edge to edge just before the concrete becomes non-plastic. Slightly overlap adjacent strokes of the broom. Broom perpendicular to centerline of pavement so that corrugations produced will be uniform in character and width, and not more than 1/16 inch in depth. Broomed surface shall be free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near the surface.

3.5.2.3 Wire-Comb Texturing

Surface texture transverse to the pavement center line shall be applied using a mechanical wire comb drag. The comb shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the comb shall be overlapped the

minimum necessary to obtain a continuous and uniformly textured surface. The scores shall be 1/16 to 3/16 inch deep, 1/16 to 1/8 inch wide, and spaced 3/8 inch apart.

3.5.2.4 Surface Grooving

The areas indicated on the drawings shall be grooved with a spring tine drag producing individual grooves 1/4 inch deep and 1/4 inch wide at a spacing between groove centerlines of 2 inches. These grooves shall be cut perpendicular to the centerline. Before grooving begins, the concrete shall be allowed to stiffen sufficiently to prevent dislodging of aggregate. Grooves shall not be cut within 6 inches of a transverse joint or crack.

3.5.3 Edging

At the time the concrete has attained a degree of hardness suitable for edging, carefully finish slab edges, including edges at formed joints, with an edge having a maximum radius of one-eighth inch. When brooming is specified for the final surface finish, edge transverse joints before starting brooming, then operate broom to obliterate as much as possible the mark left by the edging tool without disturbing the rounded corner left by the edger. Clean by removing loose fragments and soupy mortar from corners or edges of slabs which have crumbled and areas which lack sufficient mortar for proper finishing. Refill voids solidly with a mixture of suitable proportions and consistency and refinish. Remove unnecessary tool marks and edges. Remaining edges shall be smooth and true to line.

3.5.4 Repair of Surface Defects

Follow guidance of ACI 301.

3.6 CURING AND PROTECTION

Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use White-Burlap-Polyethylene Sheet or liquid membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on surfaces to be painted, where coverings are to be bonded to concrete, or on concrete to which other concrete is to be bonded. Maintain temperature of air next to concrete above 40 degrees F for the full curing periods.

3.6.1 White-Burlap-Polyethylene Sheet

Wet entire exposed surface thoroughly with a fine spray of water, saturate burlap but do not have excessive water dripping off the burlap and then cover concrete with White-Burlap-Polyethylene Sheet, burlap side down. Lay sheets directly on concrete surface and overlap 12 inches. Make sheeting not less than 18 inches wider than concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets when damaged during curing. Check daily to assure burlap has not lost all moisture. If moisture evaporates, resaturate burlap and re-place on pavement (re-saturation and re-placing shall take no longer than 10 minutes per sheet). Leave sheeting on concrete surface to be cured for at least 7 days.

3.6.2 Liquid Membrane-Forming Compound Curing

Apply compound immediately after surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. Total coverage for the two coats shall be at least one gallon of undiluted compound per 200 square feet. Compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat of compound immediately to areas where film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after curing compound has been applied in the same manner.

3.6.2.1 Protection of Treated Surfaces

Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from vehicular traffic and other sources of abrasion for not less than 72 hours. Foot traffic is allowed after 24 hours for inspection purposes. Maintain continuity of coating for entire curing period and repair damage to coating immediately.

3.6.3 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. The sealer-hardener shall not be applied 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.

3.7 FIELD QUALITY CONTROL

3.7.1 Sampling

The Contractor's approved laboratory shall collect samples of fresh concrete in accordance with ASTM C172/C172M during each working day as required to perform tests specified herein. Make test specimens in accordance with ASTM C31/C31M.

3.7.2 Consistency Tests

The Contractor's approved laboratory shall perform concrete slump tests in accordance with ASTM C143/C143M. Take samples for slump determination from concrete during placement. Perform tests at the beginning of a concrete placement operation and and for each batch (minimum) or every 20 cubic yards (maximum) of concrete to ensure that specification requirements are met. In addition, perform tests each time test beams and cylinders are made.

3.7.3 Flexural Strength Tests

The Contractor's approved laboratory shall test for flexural strength in accordance with ASTM C78/C78M. Make four test specimens for each set of tests. Test two specimens at 7 days, and the other two at 28 days. Concrete strength will be considered satisfactory when the minimum of the 28-day test results equals or exceeds the specified 28-day flexural strength, and no individual strength test is less than 650 pounds per square inch. If the ratio of the 7-day strength test to the specified

28-day strength is less than 65 percent, make necessary adjustments for conformance. Frequency of flexural tests on concrete beams shall be not less than four test beams for each 50 cubic yards of concrete, or fraction thereof, placed. Concrete which is determined to be defective, based on the strength acceptance criteria therein, shall be removed and replaced with acceptable concrete.

3.7.4 Air Content Tests

Test air-entrained concrete for air content at the same frequency as specified for slump tests. Determine percentage of air in accordance with ASTM C231/C231M on samples taken during placement of concrete in forms.

3.7.5 Surface Testing

Surface testing for surface smoothness , slump and plan grade shall be performed as indicated below by the Testing Laboratory. The measurements shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Government within 24 hours after measurement is made. A final report of surface testing, signed by a Registered Engineer, containing all surface measurements and a description of all actions taken to correct deficiencies, shall be provided to the Government upon conclusion of surface testing.

3.7.5.1 Surface Smoothness Requirements

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 when checked with a 12 foot straightedge: 1/5 inch longitudinal and 1/4 inch transverse directions for roads and streets and 1/4 inch for both directions for other concrete surfaces, such as parking areas.

3.7.5.2 Surface Smoothness Testing Method

The surface of the pavement shall be tested with the straightedge to identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines approximately 15 feet apart. 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 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.

3.7.6 Plan Grade Testing and Conformance

The surfaces shall vary not more than 0.06 foot above or below the plan grade line or elevation indicated. Each pavement category shall be checked by the Contractor for conformance with plan grade requirements by running lines of levels at intervals to determine the elevation at each joint intersection.

3.7.7 Test for Pavement Thickness

Measure during concrete placement to determine in-place thickness of concrete pavement.

3.7.8 Reinforcement

Inspect reinforcement prior to installation to assure it is free of loose flaky rust, loose scale, oil, mud, or other objectionable material.

3.7.9 Dowels

Inspect dowel placement prior to placing concrete to assure that dowels are of the size indicated, and are spaced, aligned and painted and oiled as specified. Dowels shall not deviate from vertical or horizontal alignment after concrete has been placed by more than 1/8 inch per foot.

3.8 WASTE MANAGEMENT

In accordance with the Waste Management Plan.

-- End of Section --

SECTION 32 16 13

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
04/08

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 615/A 615M	(2009) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	(2009) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Provide plant, equipment, machines, and tools used in the work subject to approval and maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance

with specifications.

1.2.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

1.3 SUBMITTALS

For all concrete submittals, refer to specification Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. 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.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 2 to 4 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 1 to 4 inches plus or minus 1 inch where determined in accordance with ASTM C 143/C 143M.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A 615M. Wire mesh reinforcement shall conform to ASTM A 185/A 185M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1752, Type I, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C 920.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits

or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 31 00 00 EARTHWORK.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope as indicated with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas

which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints

are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D 1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or stone in color. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Contraction joints (except for slip forming) shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, the contraction joints shall be cut in the top portion of the gutter/curb hardened concrete in a continuous

cut across the curb and gutter, using a power-driven saw. The depth of cut shall be at least one-fourth of the gutter/curb depth and 1/8 inch in width.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not less than 30 feet nor greater than 120 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inch depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. 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. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, 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 resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. 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.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete

to receive a protective coating shall be moist cured.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

3.8 SURFACE DEFICIENCIES AND CORRECTIONS

3.8.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.8.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.8.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

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.

ASTM INTERNATIONAL (ASTM)

ASTM D 4280	(2008) Extended Life Type, Nonplowable, Raised, Retroreflective Pavement Markers
ASTM D 4505	(2005) Preformed Retroflective Pavement Marking Tape for Extended Service Life
ASTM D 792	(2008) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM E 28	(1999; R 2009) Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732	(1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325	(Rev C) Beads (Glass Spheres) Retro-Reflective (Metric)
FS TT-P-1952	(Rev D) 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 roads and streets

Paints for roads and streets

Thermoplastic compound

Raised Pavement Markers and Adhesive

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.

SD-08 Manufacturer's Instructions

Paints for roads and streets

Thermoplastic compound

Submit manufacturer's Material Safety Data Sheets.

1.3 DELIVERY AND STORAGE

Deliver paints, paint materials and thermoplastic compound 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 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

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

1.5.2.1 Hand-Operated, Push-Type Machines

Provide hand-operated push-type applicator machine of a type commonly used for application of paint to pavement surfaces. Paint applicator machine shall be acceptable for marking small street and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. 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.

1.5.3 Thermoplastic Application Equipment

1.5.3.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.5.3.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.5.3.3 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. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

1.5.3.4 Mobile Application Equipment

The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.040 to 0.200 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall

be used. Heating of the composition by direct flame shall not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle.

The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

1.5.3.5 Portable Application Equipment

The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425 degrees F, of extruding a line of 3 to 12 inches in width, and in thickness of not less than 0.120 inch nor more than 0.190 inch and of generally uniform cross section.

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.

1.5.5 Preformed Tape Application Equipment

Mechanical application equipment shall be used for the placement of preformed marking tape. Mechanical application equipment shall be defined as a mobile pavement marking machine specifically designed for use in applying precoated, pressure-sensitive pavement marking tape of varying widths, up to 12 inches. The applicator shall be equipped with rollers, or other suitable compactive device, to provide initial adhesion of the preformed, pressure-sensitive marking tape with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the thermoplastic tape.

1.5.6 Surface Preparation Equipment

1.5.6.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of

oil and water.

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.

1.5.7.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

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.

1.5.8 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6 MAINTENANCE OF TRAFFIC

1.6.1 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.

1.6.2 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

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.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials conforming to the requirements specified herein.

2.1.1 Paints for Roads and Streets

FS TT-P-1952, color as indicated .

2.1.2 Reflective Media for Roads and Streets

FS TT-B-1325, Type I, Gradation A.

2.1.3 Thermoplastic Compound

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.1.3.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

	Percent by Weight	
Component	White	Yellow
Binder	17 min	17 min
Titanium dioxide	10 min	-
Glass beads	20 min	20 min
Calcium carbonate and inert fillers	49 min	*
Yellow pigments	-	*

*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2.1.3.2 Physical Properties

a. Drying time: When installed at 70 degrees F and in thicknesses between 0.120 and 0.190 inch, the composition shall be completely solid and shall show no damaging effect from traffic after curing 15 minutes.

b. Softening point: The composition shall have a softening point of not less than 194 degrees F when tested in accordance with ASTM E 28.

c. Specific gravity: The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D 792.

2.1.3.3 Primer

a. Asphalt concrete primer: The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch, plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

b. Portland cement concrete primer: The primer for portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition.

2.1.4 PREFORMED TAPE

The preformed tape shall be an adherent reflectorized strip in accordance with ASTM D 4505 Type I or IV, Class optional.

2.1.5 Raised Pavement Markers

Either metallic or nonmetallic markers of the button or prismatic reflector type may be used. Markers shall be of permanent colors as specified for pavement marking, and shall retain the color and brightness under the action of traffic. Button markers shall have a diameter of not less than 4 inches, and shall be spaced not more than 40 feet apart on solid longitudinal lines. Button markers shall have rounded surfaces presenting a smooth contour to traffic and shall not project more than 3/4 inch above level of pavement. Pavement markers and adhesive epoxy shall conform to ASTM D 4280

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Allow new pavement surfaces to cure for a period of not less than 30 days 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 rubber deposits, existing paint markings, residual curing compounds, and other coatings adhering to the pavement by water blasting. For Portland Cement Concrete pavement, grinding, light shot blasting, and light scarification,

to a resulting profile equal to ICRI 03732 CSP 2, CSP 3, and CSP 4, respectively, can be used in addition to water blasting, to either remove existing coatings or for surface preparation on most pavements: shot blasting shall not be used on airfield pavements due to the potential of Foreign Object Damage (FOD) to aircraft. 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.

3.1.1 Early Painting of Rigid Pavements

Pretreat rigid pavements that require early painting with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride. Apply the solution to the areas to be marked.

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 road and street pavement at a rate of (6) 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.

3.2.2.3 Thermoplastic Compound

After surface preparation has been completed, prime the asphalt or concrete pavement surface with spray equipment. Allow primer materials to "set-up" prior to applying the thermoplastic composition. Allow the asphalt concrete primer to dry to a tack-free condition, usually occurring in less than 10 minutes. Apply asphalt concrete primer to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch 265 to 400 square feet per gallon. After the primer has "set-up", apply the thermoplastic at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, apply drop-on reflective glass spheres mechanically at the rate of one pound per 20 square feet such that the spheres are held by and imbedded in the surface of the molten material. Apply all extruded thermoplastic markings at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch. Apply all sprayed thermoplastic markings at the specified width and the thickness designated in the contract plans. If the plans do not specify a thickness, apply centerline markings at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch, plus or minus 0.005 inch.

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.

3.2.5 Thermoplastic Compound

Place thermoplastic pavement markings upon dry pavement. At the time of installation the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint. Apply all centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator. Place all special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable applicator, using the extrusion method.

3.2.6 Raised Pavement Markers

Prefabricated markers shall be aligned carefully at the required spacing or as directed and permanently fixed in place by means of epoxy adhesives. To ensure good bond, areas where markers will be set shall be thoroughly cleaned by water blasting and use of compressed air prior to applying adhesive.

3.3 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.

3.4 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.

3.4.1 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.

3.4.2 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% of the beads embedded and 50% of the beads exposed.

-- End of Section --

SECTION 32 92 19

SEEDING
10/06

PART 1 GENERAL

1.1 REFERENCES

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

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

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
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

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK 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 information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

SD-07 Certificates

State certification and approval for seed

SD-08 Manufacturer's Instructions

Erosion Control Materials

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer and Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Contracting Officer.

2.1.2 Planting Dates

Planting Season	Planting Dates
Season 1	March - September
Temporary Seeding	September - January

2.1.3 Seed Purity

Botanical Name	Common Name	Min. Percent Pure Seed	Min. Percent Germination and Hard Seed	Max. Percent Weed Seed
Cynodon Dactylon	Common Bermuda Grass	90	90	1

2.1.4 Seed Mixture by Weight

Planting Season	Variety	Percent (by Weight)
Season 1	Common Bermuda Grass	98

Proportion seed mixtures by weight. Temporary seeding must later be replaced by Season 1 plantings for a permanent stand of grass. The same requirements of turf establishment for Season 1 apply for temporary seeding.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00 EARTHWORK.

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	7 to 17 percent
Clay	10 to 30 percent
Sand	70 to 82 percent
pH	5.5 to 7.0
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 of not less than 2 percent.

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 61 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.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

12 percent available nitrogen
8 percent available phosphorus
8 percent available potassium
2 percent sulfur

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.

2.6 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

2.7 EROSION CONTROL MATERIALS

Erosion control material shall conform to the following:

2.7.1 Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.7.2 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of off-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.

3.1.1.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Lime 50 pounds per 1000 square feet.

3.1.1.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer 1 pound per 1000 square feet.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when

ground is muddy, frozen or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method shall be broadcasted and drop seeding.

3.2.2.1 Broadcast and Drop Seeding

Seed shall be uniformly broadcast at the rate of 4-6 pounds per 1000 square feet. Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.2.3.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.2.5 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Contracting Officer.

3.2.6 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 33 11 00

WATER DISTRIBUTION
10/06

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C104/A21.4	(2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(2002; R 2003) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2005) Dry-Barrel Fire Hydrants
AWWA C508	(2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C702	(2001) Cold-Water Meters - Compound Type
AWWA C706	(1996; R 2005) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C800	(2005) Underground Service Line Valves and Fittings

AWWA C900	(2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA C905	(1997) Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 In. Through 48 In. (350 mm through 1,200 mm)
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation

ASME INTERNATIONAL (ASME)

ASME B16.26	(2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

ASTM INTERNATIONAL (ASTM)

ASTM B 61	(2008) Standard Specification for Steam or Valve Bronze Castings
ASTM B 62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM C 94/C 94M	(2009) Standard Specification for Ready-Mixed Concrete
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 477	(2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 325	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 49	(2003) Hazardous Chemicals Data
NFPA 704	(2006) Identification of the Hazards of Materials for Emergency Response

UNDERWRITERS LABORATORIES (UL)

UL 246	(1993; Rev thru Dec 1998) Hydrants for Fire-Protection Service
UL 262	(2004) Standard for Gate Valves for Fire-Protection Service
UL 312	(2004; Rev thru Jun 2009) Check Valves for Fire-Protection Service
UL 789	(2004; Rev thru Aug 2008) Indicator Posts for Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)

1.2 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

Provide water distribution mains indicated as 4 through 12 inch diameter pipe sizes of polyvinyl chloride (PVC) plastic pipe. Also provide water main accessories, gate valves and check valves as specified and where indicated.

1.2.2 Water Service Lines

Provide water service lines indicated as less than 4 inch lines from water distribution main to building service at the points indicated. Water service lines shall be polyvinyl chloride (PVC) plastic pipe . Provide water service line appurtenances as specified and where indicated.

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

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Indicator posts

Corporation stops

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-06 Test Reports

Bacteriological Disinfection.

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Lining

Fire hydrants

Compound Type Meters

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be

kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.4.2.1 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC) pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Polyvinyl Chloride (PVC) Plastic Piping

a. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) with cast-iron-pipe-equivalent OD.

b. Pipe 14 through 36 diameter: AWWA C905.

c. Fittings for PVC pipe: Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph. Iron fittings and specials shall be cement-mortar lined in accordance with AWWA C104/A21.4.

d. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves on Buried Piping

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends or resilient-seated gate valves 3 to 12 inches in size, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 150 psi, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of mechanical-joint ends and push-on joint ends, valves may have special ends for connection to sleeve-type mechanical coupling. Valve ends and gaskets for connection to sleeve-type mechanical coupling shall conform to the applicable requirements specified respectively for the joint or coupling. Where a post indicator is shown, the valve shall have an indicator post flange; indicator post flange for AWWA C500 valve shall conform to the applicable requirements of UL 262. Valves shall be of one manufacturer.

2.1.2.2 Gate Valves

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with solid-wedge gates and flanged ends, (2) AWWA C509 shall be nonrising stem type with flanged ends, and (3) UL 262 shall be outside-screw-and-yoke type, shall have solid or one-piece type gate and flanged ends, and shall be designed for a hydraulic working pressure of 150 psi. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500.

2.1.2.3 Check Valves

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have iron or steel body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends, and designed for a working pressure of 150 psi. Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. Valves shall be spring-loaded . Flanges shall be Class 125 conforming to ASME B16.1.

2.1.2.4 Pressure Reducing Valves

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for 150 psi operating pressure on the inlet side, with outlet pressure set for 65 psi. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be threaded . Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be

bronze. Pilot controls shall be bronze with stainless steel working parts.

2.1.2.5 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.2.6 Fire Hydrants

Dry-barrel type . Paint hydrants with at least one coat of primer and two coats of yellow enamel paint, except use red enamel paint for tops of hydrants in non-potable water systems. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

a. Dry-Barrel Type Fire Hydrants: Dry-barrel type hydrants, AWWA C502 or UL 246, "Base Valve" design, shall have 6 inch inlet, 5 1/4 inch valve opening, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Inlet shall have mechanical-joint end only ; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as specified in AWWA C502 or UL 246 . Hydrants indicated as "traffic type," shall have frangible sections as mentioned in AWWA C502 . The traffic type hydrant shall have special couplings joining upper and lower sections of hydrant barrel and shall be designed to have the special couplings break from a force not less than that which would be imposed by a moving vehicle; hydrant shall operate properly under normal conditions.

2.1.2.7 Indicator Posts

UL 789. Provide for gate valves where indicated.

2.1.2.8 Valve Boxes

Provide a valve box for each gate valve on buried piping . Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Cast-iron boxes shall have a minimum cover and wall thickness of 3/16 inch. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.2.9 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation

Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

a. Polyvinyl Chloride (PVC) Plastic Piping with Elastomeric-Gasket Joints:

Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified.

b. Polyvinyl Chloride (PVC) Plastic Piping with Solvent Cement Joints:

Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Curb or Service Stops

Ground key, round way, inverted key type; made of bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

2.2.2.3 Service Clamps

Service clamps used for repairing damaged cast-iron, steel, PVC or asbestos-cement pipe shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.2.2.4 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.2.5 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or

trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring type.

a. Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

2.2.2.6 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches as indicated. Cast-iron box shall have a heavy coat of bituminous paint.

2.2.2.7 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.2.2.8 Compound Type Meters

Compound type meters shall conform to AWWA C702 and shall be furnished with strainers. The main casing shall be bronze with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons . The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 . Meters shall comply with the accuracy and capacity requirements of AWWA C702.

2.2.2.9 Meter Boxes

Meter boxes shall be of cast iron, concrete, or plastic. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall use concrete covers with cast iron meter reader lids . Plastic boxes and lids shall be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

2.2.2.10 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building. Do not lay water lines in the same trench with gas lines fuel lines or electric wiring.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to

prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure as indicated .

3.1.1.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.1.7 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

b. Offset: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) or metal harness for pipe anchorage as indicated on the drawings. Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts

gravel, having the same minimum compressive strength. Metal harness shall be as indicated.

d. Fittings: Install in accordance with AWWA C605.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test PVC plastic water mains and water service lines made with PVC plastic water main pipe in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 33 30 00

SANITARY SEWERS
04/08

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C900	(2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C 443	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and

	Laterals
ASTM C 94/C 94M	(2009) Standard Specification for Ready-Mixed Concrete
ASTM C 969	(2002; R 2009) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 972	(2000; R 2006) Compression-Recovery of Tape Sealant
ASTM C 990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 1784	(2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2321	(2005) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2002; R 2008) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2680	(2001; R 2009) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3753	(2005e1) Glass-Fiber-Reinforced Polyester Manholes and Wetwells
ASTM D 4101	(2009) Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM D 412	(2006ae1e2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 624	(2000; R 2007) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 477	(2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 949	(2009) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-60005	(Basic) Frames.Covers, Gratings, Steps, Sump and Catch Basin, Manhole

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

29 CFR 1910.27	Fixed Ladders

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of polyvinyl chloride (PVC) plastic pipe . Provide building connections of polyvinyl chloride (PVC) plastic pipe. Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

1.2.2 Sanitary Sewer Pressure Lines

Provide pressure lines of polyvinyl chloride (PVC) plastic pressure pipe .

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Drawings

Installation and As-Built drawings, as specified.

Precast concrete manhole
Metal items
Frames, covers, and gratings

Details, as specified.

SD-03 Product Data

Pipeline materials

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports

Reports

Test and inspection reports, as specified.

1.4 QUALITY ASSURANCE

1.4.1 Drawings

b. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

1.5.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.5.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 PVC Plastic Gravity Sewer Piping

2.1.1.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.1.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.2 PVC Plastic Pressure Pipe and Associated Fittings

2.1.2.1 PVC Plastic Pressure Pipe and Fittings

a. Pipe and Fittings Less Than 4 inch Diameter: Pipe, couplings and fittings shall be manufactured of materials conforming to ASTM D 1784, Class 12454B.

(1) Push-On Joint: ASTM D 3139, with ASTM F 477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110/A21.10 or AWWA C111/A21.11. Iron fittings and specials shall shall be cement-mortar lined (standard thickness) in accordance with AWWA C104/A21.4.

(2) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure. Fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467.

b. Pipe and Fittings 4 inch Diameter to 12 inch: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.2.2 PVC Plastic Pressure Joints and Jointing Material

Joints for pipe, 4 inch to 12 inch diameter, shall be push-on joints as

specified in ASTM D 3139. Joints between pipe and fittings shall be push-on joints as specified in ASTM D 3139 or shall be compression-type joints/mechanical-joints as respectively specified in ASTM D 3139 and AWWA C111/A21.11. Each joint connection shall be provided with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipe and fittings shall be as specified in AWWA C111/A21.11, respectively, for push-on joints and mechanical-joints.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Precast Concrete Manholes & Glass-Fiber-Reinforced Polyester Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478; base and first riser shall be monolithic.
Glass-Fiber-Reinforced Polyester Manholes shall conform to ASTM D 3753.

2.2.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923 or ASTM C 990.

2.2.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Proplene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, psi	ASTM D 412	1840	2195	-
Elongation percent	ASTM D 412	553	295	350
Tear Resistance, ppi	ASTM D 624 (Die B)	280	160	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12

2.2.4 Metal Items

2.2.4.1 Frames, Covers, and Gratings for Manholes

FS A-A-60005, cast iron; figure numbers shall be as indicated.

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.2.4.2 Manhole Steps

As indicated conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

2.2.4.3 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.2.4.4 Septic Tank Piping

Cast iron soil pipe and fittings.

2.2.4.5 Siphon for Septic Tank

Welded steel or close-grained cast iron free from flaws, of an approved standard design, and prompt and positive in action.

2.3 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 00 00 EARTHWORK. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5

feet from the building . Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 10 feet to a water main or service line. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 2 feet below bottom of water line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 10 feet on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 feet, horizontal distance, to the water line.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.2 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of AWWA C605 for laying of pipe,

joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less Than 4 Inch Diameter:

1 Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

2 Solvent-weld joints shall comply with the manufacturer's instructions.

b. Pipe 4 Inch Diameter Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.3 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete

piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.4 Miscellaneous Construction and Installation

3.1.4.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.4.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.1.5 Installations of Wye Branches

Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.

b. Low-pressure air tests: Perform tests as follows:

1 PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the

mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

1 A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

2 Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

3 Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

4 Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.2.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 50 psi in excess of the maximum working pressure of the system, but not less than 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Test PVC plastic pressure lines in accordance with the requirements of AWWA C605 for pressure and leakage tests, using the allowable leakage given therein.

3.2.4 Field Tests for Concrete

Field testing requirements are covered in Section 31 00 00 EARTHWORK.

-- End of Section --