

# Fort Ruger Building 300A Office Improvement

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State of Hawaii Department of Defense  
Hawaii Army National Guard

## 100% Final Design Specifications

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SECTION 01 81 13

SUSTAINABLE DESIGN REQUIREMENTS

10/15

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 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.

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001 (2000) Principles and Criteria for Forest Stewardship

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS Scientific Certification Systems (SCS)Indoor Advantage

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

40 CFR 59 National Volatile Organic Compound Emissions Standard for Consumers and Commercial Products

1.3 DEFINITIONS

1.3.1 Biobased Product

As defined in the 2002 Farm Bill, a product determined by the Secretary to be a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials.

1.3.2 Biobased Content

The weight of the biobased material divided by the total weight of the product and expressed as a percentage by weight.

1.3.3 Certificates of Chain-of-Custody

Certificates signed by manufacturers certifying that wood used to make products has been tracked through its extraction and fabrication to ensure that is was obtained from forests certified by a specified certification program.

1.3.4 Post-Consumer Recycled Content

The percentage by weight of constituent materials that have been recovered

or otherwise diverted from the solid-waste stream after consumer use.

#### 1.3.5 Pre-Consumer Recycled Content:

Materials that have been recovered or otherwise diverted from the solid-waste stream during the manufacturing process. Pre-consumer content must be material that would not have otherwise entered the waste stream as per Section 5 of the FTC Act, Part 260 "Guidelines for the Use of Environmental Marketing Claims":[www.ftc.gov/bcp/grnrule/guides980427](http://www.ftc.gov/bcp/grnrule/guides980427)

#### 1.3.6 Recycled Content Materials

Products that contain pre-consumer or post-consumer materials as all or part of their feedstock.

#### 1.3.7 Salvaged or Reused Materials

Materials extracted from existing buildings in order to be reused in other buildings without being manufactured.

#### 1.3.8 Sealant

Any material that fills and seals gaps between other materials.

#### 1.3.9 Volatile Organic Compounds (VOCs)

Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. Compounds that have negligible photochemical reactivity, listed in EPA 40 CFR 51.100(s), are also excluded from this regulatory definition.

## PART 2 PRODUCTS

### 2.1 PRODUCT ENVIRONMENTAL REQUIREMENTS

#### 2.1.1 Recycled Content of Materials

Materials with recycled content are preferred for this project. At a guideline, the materials in the following list should contain the minimum recycled content indicated:

Category	Minimum Recycled Content
Steel Studs	30% combined
Aluminum Fabrications	35% combined
Batt insulation	30% combined
Rock Wool Insulation	75% pre-consumer
Fireproofing	20% combined

Category	Minimum Recycled Content
Gypsum Wallboard	100% combined
Carpet	40% combined
Rubber Flooring and Base	60% combined
Acoustical Ceiling Tile (ACT)	40% post-consumer
ACT Suspension System	90% post-consumer

## 2.1.2 Biobased Products

### 2.1.2.1 Wood-based Materials

Items include but are not limited to the following materials (when made from wood), engineered wood products, or wood-based panel products:

- a. Miscellaneous carpentry.
- b. Plywood.
- c. Finish carpentry.
- d. Architectural woodwork.
- e. Wood doors.

### 2.1.2.2 Solid Wood Products

All new solid-wood-based materials will be certified as "FSC 100%" FSC STD 01 001 by an independent third party in accordance with FSC Forest Stewardship Council "Principles and Criteria" and will have received Chain-of-Custody Certification as certified by an accredited certification group such as Smartwood or Scientific Certification Systems (SCS).

### 2.1.2.3 Other Wood Products:

Other Wood Products: All other new wood-based materials will be certified by an independent third party in accordance with FSC, Forest Stewardship Council "Principles and Criteria" and has received Chain-of-Custody Certification as certified by an accredited certification group such as Smartwood or Scientific Certification Systems (SCS).

## 2.1.3 Adhesives and Sealants

### 2.1.3.1 Certification

All adhesives and sealants used inside the building's thermal envelope must be third-party certified by Indoor Advantage Plus SCS from Scientific Certification Systems, Inc.

#### 2.1.3.2 VOC Limits

All adhesives and sealants, regardless of where they are used, must comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24):

- a. Wood Glues: 20 g/L.
- b. Millwork and Casework Adhesives: 20g/L.
- c. Metal to Metal Adhesives: 30 g/L.
- d. Adhesives for Porous Materials (Except Wood): 50 g/L.
- e. Subfloor Adhesives: 50 g/L.
- f. Carpet Adhesives: 50 g/L.
- g. Carpet Seam Sealer: 50g/L.
- h. Cove Base Adhesives: 50 g/L.
- i. Rubber Floor Adhesives: 60 g/L.
- j. Gypsum Board and Panel Adhesives: 50 g/L.
- k. Gypsum Drywall Joint Compound: 20 g/L.
- l. Multipurpose Construction Adhesives: 70 g/L.
- m. General Contact Adhesive: 80 g/L.
- n. Structural Glazing Adhesives and Compounds: 100 g/L.
- o. Silicone Sealant: 50 g/L.
- p. Pipe Thread Sealant: 50 g/L.
- q. Duct Sealant: 10 g/L.
- r. Plastic Cement Welding Compounds: 250 g/L.
- s. ABS Welding Compounds: 400 g/L.
- t. CPVC Welding Compounds: 270 g/L.
- u. PVC Welding Compounds: 150 g/L.
- v. Adhesive Primer for Plastic: 250 g/L.
- w. Architectural Sealants: 250 g/L.

#### 2.1.3.3 Restrictions

- a. Interior sealants shall not contain mercury, butyl rubber, neoprene, SBR (styrene butadiene rubber), or nitrile.
- b. Sealants and glazing compounds formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure)

fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, or their components shall not be used.

- c. Adhesives used to apply laminates, whether shop-applied or field-applied, shall contain no urea-formaldehyde.

PART 3 EXECUTION

Not used.

-- End of Section --



SECTION 02 41 00

DEMOLITION  
05/10

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety and Health Requirements Manual

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

40 CFR 61 National Emission Standards for Hazardous Air Pollutants

40 CFR 82 Protection of Stratospheric Ozone

1.2 PROJECT DESCRIPTION

1.2.1 General Requirements

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. The work includes demolition, , salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements . Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

### 1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

### 1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

### 1.3.3 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations..

### 1.3.4 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

## 1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted. Where burning is permitted, adhere to federal, state, and local regulations.

## 1.5 QUALITY ASSURANCE

Submit timely notification of demolition and renovation projects to as required to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the the appropriate authorities and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

### 1.5.1 Hawaii Requirements

Complete and submit Notification of Demolition and Renovation form to Federal and State authorities and Contracting Officer, postmarked or delivered at least ten working days prior to commencement of work, in accordance with 40 CFR 61, Subpart M.

### 1.5.2 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to flooding, or pollution. Vacuum and dust the work area daily .

## 1.6 PROTECTION

### 1.6.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

### 1.6.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

## 1.7 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

## 1.8 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

### 3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled.

Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

### 3.1.1 Structures

- a. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

### 3.1.2 Utilities and Related Equipment

#### 3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided.

### 3.1.3 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated. Provide square, straight edges and corners where existing masonry adjoins new work and other locations.

### 3.1.4 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

### 3.1.5 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

### 3.1.6 Carpentry

Salvage for reuse lumber, millwork items, and finished boards, and sort by type and size.

### 3.1.7 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

- a. Concrete and Masonry: Completely fill holes and depressions, left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

### 3.1.8 Air Conditioning Equipment

Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

### 3.1.9 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

### 3.1.10 Locksets on Swinging Doors

Remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the Contracting Officer after removal.

### 3.1.11 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Do not offer low-efficiency equipment for reuse.

## 3.2 DISPOSITION OF MATERIAL

### 3.2.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

### 3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

### 3.2.3 Salvaged Materials and Equipment

Remove materials and equipment that are indicated to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site as directed.

- a. Salvage items and material to the maximum extent possible.
- b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. On site sales of salvaged material is prohibited.
- c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers.

### 3.2.4 Disposal of Ozone Depleting Substance (ODS)

Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

### 3.2.5 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable combustible material off the site .

## 3.3 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

## 3.4 DISPOSAL OF REMOVED MATERIALS

### 3.4.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified . Storage of removed materials on the project site is prohibited.

### 3.4.2 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

## 3.5 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations

or restore them as necessary to usable condition.

-- End of Section --

SECTION 02 82 16.00 20

ENGINEERING CONTROL OF ASBESTOS CONTAINING MATERIALS  
**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 INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z88.6 (2006) Respiratory Protection - Respirator Use-Physical Qualifications for Personnel

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE Z9.2 (2012) Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems

ASTM INTERNATIONAL (ASTM)

ASTM C732 (2006; R 2012) Aging Effects of Artificial Weathering on Latex Sealants

ASTM E119 (2014) Standard Test Methods for Fire Tests of Building Construction and Materials

ASTM E736 (2000; R 2011) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

ASTM E84 (2015b) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E96/E96M (2014) Standard Test Methods for Water Vapor Transmission of Materials

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

29 CFR 1926.103 Respiratory Protection

29 CFR 1926.1101 Asbestos

29 CFR 1926.200 Accident Prevention Signs and Tags

29 CFR 1926.59 Hazard Communication

40 CFR 61-SUBPART A General Provisions

40 CFR 61-SUBPART M National Emission Standard for Asbestos



40 CFR 763

Asbestos

UNDERWRITERS LABORATORIES (UL)

UL 586

(2009; Reprint Sep 2014) Standard for  
High-Efficiency Particulate, Air Filter  
Units

1.2 DEFINITIONS

1.2.1 ACM

Asbestos Containing Materials.

1.2.2 Amended Water

Water containing a wetting agent or surfactant with a maximum surface  
tension of 0.00042 psi.

1.2.3 Area Sampling

Sampling of asbestos fiber concentrations which approximates the  
concentrations of asbestos in the theoretical breathing zone but is not  
actually collected in the breathing zone of an employee.

1.2.4 Asbestos

The term asbestos includes chrysotile, amosite, crocidolite, tremolite  
asbestos, anthophyllite asbestos, and actinolite asbestos and any of these  
minerals that has been chemically treated or altered. Materials are  
considered to contain asbestos if the asbestos content of the material is  
determined to be at least one percent.

1.2.5 Asbestos Control Area

That area where asbestos removal operations are performed which is isolated  
by physical boundaries which assist in the prevention of the uncontrolled  
release of asbestos dust, fibers, or debris.

1.2.6 Asbestos Fibers

Those fibers having an aspect ratio of at least 3:1 and longer than 5  
micrometers as determined by National Institute for Occupational Safety and  
Health (NIOSH) Method 7400.

1.2.7 Asbestos Permissible Exposure Limit

0.1 fibers per cubic centimeter of air as an 8-hour time weighted average  
measured in the breathing zone as defined by 29 CFR 1926.1101 or other  
Federal legislation having legal jurisdiction for the protection of workers  
health.

1.2.8 Background

The ambient airborne asbestos concentration in an uncontaminated area as  
measured prior to any asbestos hazard abatement efforts. Background  
concentrations for other (contaminated) areas are measured in similar but  
asbestos free locations.

#### 1.2.9 Contractor

The Contractor is that individual, or entity under contract to the Navy to perform the herein listed work.

#### 1.2.10 Encapsulation

The abatement of an asbestos hazard through the appropriate use of chemical encapsulants.

#### 1.2.11 Encapsulants

Specific materials in various forms used to chemically or physically entrap asbestos fibers in various configurations to prevent these fibers from becoming airborne. There are four types of encapsulants as follows which must comply with performance requirements as specified herein.

- a. Lock-Down Encapsulant (used to seal off or "lock-down" minute asbestos fibers left on surfaces from which asbestos containing material has been removed).

#### 1.2.12 Friable Asbestos Material

One percent asbestos containing material that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

#### 1.2.13 HEPA Filter Equipment

High efficiency particulate air (HEPA) filtered vacuum and/or exhaust ventilation equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall retain 99.97 percent of particles 0.3 microns or larger as indicated in UL 586.

#### 1.2.14 Negative Pressure Enclosure (NPE)

That engineering control technique described as a negative pressure enclosure in 29 CFR 1926.1101.

#### 1.2.15 Nonfriable Asbestos Material

Material that contains asbestos in which the fibers have been immobilized by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not normally release asbestos fibers during any appropriate use, handling, storage or transportation. It is understood that asbestos fibers may be released under other conditions such as demolition, removal, or mishap.

#### 1.2.16 Personal Sampling

Air sampling which is performed to determine asbestos fiber concentrations within the breathing zone of a specific employee, as performed in accordance with 29 CFR 1926.1101.

#### 1.2.17 Time Weighted Average (TWA)

The TWA is an 8-hour time weighted average airborne concentration of asbestos fibers.

1.2.18 Wetting Agent

A chemical added to water to reduce the water's surface tension thereby increasing the water's ability to soak into the material to which it is applied. An equivalent wetting agent must have a surface tension of at most 0.00042 psi.

1.3 REQUIREMENTS

1.3.1 Description of Work

The work covered by this section includes the handling and control of asbestos containing materials and describes some of the resultant procedures and equipment required to protect workers, the environment and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of any asbestos containing materials generated by the work. More specific operational procedures shall be outlined in the Asbestos Hazard Abatement Plan called for elsewhere in this specification.

Contractor shall remove and dispose of all of the following materials as ACM to safely complete this project:

Material Description	Quantity	Material Location	Condition; Friable/Non-Friable
tan VAT and black mastic	1600 sq ft	Rooms 53 (under 12" x 12" beige VFT), 58, 59, 60, 64 (under carpet), 65, and 66	no damage; non friable
green with white streaks VAT and black mastic	900 sq ft	in room 50	no damage; non friable

Contractor shall treat all asbestos-containing homogeneous area(s) within the project limits as ACM and is included as work under this Section as required to safely complete this project.

Homogeneous area(s) that is/are known to be ACM, shall be treated as ACM throughout the project limits and is/are included as work under this Section as required to safely complete this project.

Suspect ACM not previously tested or identified shall be treated as ACM unless proven otherwise. The contractor shall be responsible for all cost associated with additional asbestos testing and shall not conduct additional testing unless authorized by the Contracting Officer or it's Representative. Contractor shall not test any suspect ACM previously tested.

Under normal conditions non-friable or chemically bound materials containing asbestos would not be considered hazardous; however, this material may release airborne asbestos fibers during demolition and removal and therefore must be handled in accordance with the removal and disposal procedures as specified herein. Provide negative pressure enclosure techniques as outlined in this specification

### 1.3.2 Medical Requirements

Provide medical requirements including but not limited to medical surveillance and medical record keeping as listed in 29 CFR 1926.1101.

#### 1.3.2.1 Medical Examinations

Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1926.1101 or other pertinent State or local directives. This requirement must have been satisfied within the 12 months prior to the start of work on this contract. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. Specifically identify x-ray films of asbestos workers to the consulting radiologist and mark medical record jackets with the word "ASBESTOS."

#### 1.3.2.2 Medical Records

Maintain complete and accurate records of employees' medical examinations, medical records, and exposure data for a period of 30 years after termination of employment and make records of the required medical examinations and exposure data available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health (OSHA), or authorized representatives of them, and an employee's physician upon the request of the employee or former employee.

#### 1.3.3 Employee Training

Submit certificates, prior to the start of work but after the main abatement submittal, signed by each employee indicating that the employee has received training in the proper handling of materials and wastes that contain asbestos in accordance with 40 CFR 763; understands the health implications and risks involved, including the illnesses possible from exposure to airborne asbestos fibers; understands the use and limits of the respiratory equipment to be used; and understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment as indicated in 29 CFR 1926.1101 on an initial and annual basis. Certificates shall be organized by individual worker, not grouped by type of certification. Train all personnel involved in the asbestos control work in accordance with United States Environmental Protection Agency (USEPA) Asbestos Hazard Emergency Response Act (AHERA) training criteria or State training criteria whichever is more stringent. The Contractor shall document the training by providing: dates of training, training entity, course outline, names of instructors, and qualifications of instructors upon request by the Contracting Officer. Furnish each employee with respirator training and fit testing administered by the PQP as required by 29 CFR 1926.1101. Fully cover engineering and other hazard control techniques and procedures. All asbestos workers shall have a current State of Hawaii asbestos worker's license.

#### 1.3.4 Permits , Licenses, and Notifications

Obtain necessary permits and licenses in conjunction with asbestos removal, encapsulation, hauling, and disposition, and furnish notification of such actions required by Federal, State, regional, and local authorities prior to the start of work. Notify the State Department of Health. Indoor and Radiological Health Branch. Asbestos Abatement Office, 591 Ala Moana

Boulevard, 1st Floor, Honolulu, Hawaii 96813, and the Contracting Officer in writing 20 working days prior to commencement of work in accordance with 40 CFR 61-SUBPART M. Notify the Contracting Officer and other appropriate Government agencies in writing 20 working days prior to the start of asbestos work as indicated in applicable laws, ordinances, criteria, rules, and regulations. Submit copies of all Notifications to the Contracting Officer.

#### 1.3.5 Environment, Safety and Health Compliance

In addition to detailed requirements of this specification, comply with those applicable laws, ordinances, criteria, rules, and regulations of Federal, State, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.1101, 40 CFR 61-SUBPART A, and 40 CFR 61-SUBPART M. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification, applicable laws, rules, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirement as defined by the Government shall apply. The following laws, ordinances, criteria, rules and regulations regarding removal, handling, storing, transporting and disposing of asbestos materials apply:

- a. HAR 11-501
- b. HAR 11-503
- c. HAR 11-504.

#### 1.3.6 Respiratory Protection Program

Establish and implement a respirator program as required by AIHA Z88.6, 29 CFR 1926.1101, and 29 CFR 1926.103. Submit a written description of the program to the Contracting Officer. Submit a written program manual or operating procedure including methods of compliance with regulatory statutes.

##### 1.3.6.1 Respirator Program Records

Submit records of the respirator program as required by AIHA Z88.6, 29 CFR 1926.103, and 29 CFR 1926.1101.

#### 1.3.7 Asbestos Hazard Control Supervisor

The Contractor shall be represented on site by a supervisor, trained using the model Contractor accreditation plan as indicated in the Federal statutes for all portions of the herein listed work.

#### 1.3.8 Hazard Communication

Adhere to all parts of 29 CFR 1926.59 and provide the Contracting Officer with a copy of the Material Safety Data Sheets (MSDS) for all materials brought to the site.

#### 1.3.9 Asbestos Hazard Abatement Plan

Submit a detailed plan of the safety precautions such as lockout, tagout, tryout, fall protection, and confined space entry procedures and equipment

and work procedures to be used in the removal of materials containing asbestos. The plan, not to be combined with other hazard abatement plans, shall be prepared, signed, and sealed by the PQP. Provide a Table of Contents for each abatement submittal, which shall follow the sequence of requirements in the contract. Such plan shall include but not be limited to the precise personal protective equipment to be used including, but not limited to, respiratory protection, type of whole-body protection, the location of asbestos control areas including clean and dirty areas, buffer zones, showers, storage areas, change rooms, removal method, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos sealer to be used, locations of local exhaust equipment, planned air monitoring strategies, and a detailed description of the method to be employed in order to control environmental pollution. The plan shall also include (both fire and medical emergency) response plans. The Asbestos Hazard Abatement Plan must be approved in writing prior to starting any asbestos work. The Contractor, Asbestos Hazard Control Supervisor, and PQP shall meet with the Contracting Officer prior to beginning work, to discuss in detail the Asbestos Hazard Abatement Plan, including work procedures and safety precautions. Once approved by the Contracting Officer, the plan will be enforced as if an addition to the specification. Any changes required in the specification as a result of the plan shall be identified specifically in the plan to allow for free discussion and approval by the Contracting Officer prior to starting work.

#### 1.3.10 Inspection and Monitoring by Contracting Officer

Daily environmental inspection, air monitoring and testing shall be supplied by the Contracting Officer for the purpose of verifying compliance with the specifications, insuring that the Owner's legally required documentation is collected, and providing engineering control during the project.

The Contractor shall give, at a minimum, seven (7) working days notification to the Contracting Officer's Designated Person (Air Monitoring Consultant) prior to the start of any work.

The Contractor shall not begin, or perform, with any asbestos related work without the Contracting Officer's Inspector / Air Monitoring Consultant present onsite.

Monitoring information developed by the Inspector's activities while under the contract with the State shall be for the use of the Contracting Officer. The information will be available and offered to the Contractor when developed, but not thereafter, and shall not waive the Contractor's obligations stated elsewhere in this section.

Air monitoring and testing which becomes necessary in order to follow up on work by the Contractor which is rejected as not conforming to the requirements shall be the responsibility of the Contracting Officer. However, the full cost of such additional monitoring and testing shall be borne by the Contractor, and shall be deducted from the final contract payment.

The Contractor shall be responsible for providing the employee exposure monitoring and maintaining necessary records for all of the Contractor's employees as required by OSHA, Hawaii State Law and all other applicable law.

The Contractor shall obtain the legally required reports for air monitoring as part of the contract.

#### 1.3.11 Landfill Approval

Submit written evidence that the landfill is for asbestos disposal by the and local regulatory agencies. Within 3 working days after delivery, submit detailed delivery tickets, prepared, signed, and dated by an agent of the landfill, certifying the amount of asbestos materials delivered to the landfill. Submit a copy of the waste shipment records within 1 day of the shipment leaving the project site.

#### 1.3.12 Medical Certification

Provide a written certification for each worker and supervisor, signed by a licensed physician indicating that the worker and supervisor has met or exceeded all of the medical prerequisites listed herein and in 29 CFR 1926.1101 and 29 CFR 1926.103 as prescribed by law. Submit certificates prior to the start of work but after the main abatement submittal.

#### 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 contract documents:

##### SD-03 Product Data

Local exhaust equipment; G

Vacuums; G

Respirators; G

Pressure differential automatic recording instrument; G

Amended water; G

Material Safety Data Sheets (MSDS) for all materials proposed for transport to the project site; G

Encapsulants; G

##### SD-06 Test Reports

Pressure differential recordings for local exhaust system; G

Asbestos disposal quantity report; G

##### SD-07 Certificates

Asbestos hazard abatement plan; G

Contractor's license; G

Competent person documentation; G  
Worker's license; G  
Landfill approval; G  
Employee training; G  
Medical certification requirements; G  
Waste shipment records and if applicable exemption report; G  
Respiratory Protection Program; G  
Delivery tickets; G  
Vacuums; G  
Ventilation systems; G  
Other equipment used to contain airborne asbestos fibers; G  
Chemical encapsulants sealers;; G  
Notifications

Show compliance with ASSE Z9.2 by providing manufacturers' certifications.

#### SD-11 Closeout Submittals

Notifications; G  
Rental equipment; G  
Respirator program records; G  
Permits and licenses; G

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Inspection and Monitoring by Contracting Officer

Daily environmental inspection, air monitoring and testing shall be supplied by the Contracting Officer for the purpose of verifying compliance with the specifications, insuring that the Owner's legally required documentation is collected, and providing engineering control during the project.

#### 1.5.2 Competent Person Documentation

Submit training certification and a current State of Hawaii Asbestos Contractor's and Supervisor's License.

#### 1.5.3 Worker's License

Submit documentation that requires all workers have a current State of Hawaii Asbestos Workers License.



#### 1.5.4 Contractor's License

Contractor shall have current Hawaii asbestos contractor's license. Submit a copy of the asbestos contractor's license issued by the State of Hawaii.

#### 1.5.5 Pressure Differential Recordings for Local Exhaust System

Provide a local exhaust system that creates a negative pressure of at least 0.04 inches of water relative to the pressure external to the enclosure and operate it continuously, 24 hours a day, until the temporary enclosure of the asbestos control area is removed. Submit pressure differential recordings for each work day to the Contracting Officer for review and to the Contracting Officer within 24 hours from the end of each work day.

### 1.6 EQUIPMENT

#### 1.6.1 Rental Equipment

Provide a copy of the written notification to the rental company concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

## PART 2 PRODUCTS

### 2.1 ENCAPSULANTS

Shall conform to current USEPA requirements, shall contain no toxic or hazardous substances as defined in 29 CFR 1926.59, and shall conform to the following performance requirements.

#### 2.1.1 Lock-down Encapsulant

<u>Requirement</u>	<u>Test Standard</u>
Flame Spread - 25, Smoke Emission - 50	ASTM E84
Life Expectancy - 20 years	ASTM C732 Accelerated Aging Test
Permeability - Minimum 0.4 perms	ASTM E96/E96M
Fire Resistance - Negligible affect on fire resistance rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	ASTM E119
Bond Strength: 100 pounds of force/foot	ASTM E736

Requirement	Test Standard
(Tests compatibility with cementitious and fibrous fireproofing)	

### PART 3 EXECUTION

#### 3.1 EQUIPMENT

At all times, provide the Contracting Officer or the Contracting Officer's Representative, with at least four complete sets of personal protective equipment as required for entry to and inspection of the asbestos control area. Provide equivalent training to the Contracting Officer or a designated representative as provided to Contractor employees in the use of the required personal protective equipment. Provide manufacturer's certificate of compliance for all equipment used to contain airborne asbestos fibers.

##### 3.1.1 Respirators

Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

###### 3.1.1.1 Respirators for Handling Asbestos

Provide personnel engaged in pre-cleaning, cleanup, handling, removal of asbestos materials with respiratory protection as indicated in 29 CFR 1926.1101 and 29 CFR 1926.103.

##### 3.1.2 Exterior Whole Body Protection

###### 3.1.2.1 Outer Protective Clothing

Provide personnel exposed to asbestos with disposable "non-breathable," whole body outer protective clothing, head coverings, gloves, and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort, but shall not be used alone. Make sleeves secure at the wrists, make foot coverings secure at the ankles, and make clothing secure at the neck by the use of tape.

###### 3.1.2.2 Work Clothing

Provide cloth work clothes for wear under the outer protective clothing and foot coverings and either dispose of or properly decontaminate them after each use.

###### 3.1.2.3 Personal Decontamination Unit

Exiting Work Area: Require all Workers to adhere to the following personal decontamination procedures whenever they leave the work area or at the end of work shift. 1) Before leaving the regulated work area, require the worker to remove the first or outer layer of disposable coveralls. Disposable coveralls are placed in a bag for disposal with other contaminated material. Respiratory protection should not be removed at this time. 2) The worker then proceeds to a designated area, ground level, and then removes the second set of disposable coveralls. Disposable coveralls are placed in a bag for disposal with other contaminated material. Only

after leaving the designated area, respiratory protection may be removed.

### 3.1.2.4 Eye Protection

Provide goggles to personnel engaged in asbestos abatement operations when the use of a full face respirator is not required.

### 3.1.3 Warning Signs and Labels

Provide warning signs printed in English at all approaches to asbestos control areas. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris, and other products contaminated with asbestos.

#### 3.1.3.1 Warning Sign

Provide vertical format conforming to 29 CFR 1926.200, and 29 CFR 1926.1101 minimum 20 by 14 inches displaying the following legend in the lower panel:

<u>Legend</u>	<u>Notation</u>
Danger	one inch Sans Serif Gothic or Block
Asbestos	one inch Sans Serif Gothic or Block
Cancer and Lung Disease Hazard	1/4 inch Sans Serif Gothic or Block
Authorized Personnel Only	1/4 inch Sans Serif Gothic or Block
Respirators and Protective Clothing are Required in this Area	1/4 inch Sans Serif Gothic or Block

Spacing between lines shall be at least equal to the height of the upper of any two lines.

#### 3.1.3.2 Warning Labels

Provide labels conforming to 29 CFR 1926.1101 of sufficient size to be clearly legible, displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD
BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM

#### 3.1.4 Local Exhaust System

Provide a local exhaust system in the asbestos control area in accordance with ASSE Z9.2 and 29 CFR 1926.1101 that will provide at least four air changes per hour inside of the negative pressure enclosure. Local exhaust equipment shall be operated 24 hours per day, until the asbestos control area is removed and shall be leak proof to the filter and equipped with HEPA filters. Maintain a minimum pressure differential in the control area of minus 0.04 inch of water column relative to adjacent, unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential with a pressure differential automatic recording instrument. In no case shall the building ventilation system be used as the local exhaust system for the asbestos control area. Filters on exhaust equipment shall conform to ASSE Z9.2 and UL 586. The local exhaust system shall terminate out of doors and remote from any public access or ventilation system intakes.

#### 3.1.5 Tools

Vacuums shall be leak proof to the filter and equipped with HEPA filters. Filters on vacuums shall conform to ASSE Z9.2 and UL 586. Do not use power tools to remove asbestos containing materials unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation systems. Remove all residual asbestos from reusable tools prior to storage or reuse.

#### 3.1.6 Rental Equipment

If rental equipment is to be used, furnish written notification to the rental agency concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

### 3.2 WORK PROCEDURE

Perform asbestos related work in accordance with 29 CFR 1926.1101, 40 CFR 61-SUBPART M, and as specified herein. Use wet removal procedures and negative pressure enclosure techniques. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing gum, tobacco, or applying cosmetics shall not be permitted in the asbestos work or control areas. Personnel of other trades not engaged in the removal of asbestos containing material shall not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection and training provisions of this specification are complied with by the trade personnel. Shut down the building heating, ventilating, and air conditioning system, cap the openings to the system, prior to the commencement of asbestos work. Disconnect electrical service when wet removal is performed and provide temporary electrical service with verifiable ground fault circuit interrupter (GFCI) protection prior to the use of any water. If an asbestos fiber release or spill occurs outside of the asbestos control area, stop work immediately, correct the condition to the satisfaction of the Contracting Officer including clearance sampling, prior to resumption of work.

#### 3.2.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent work. Where such

work is damaged or contaminated as verified by the Contracting Officer using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government as deemed appropriate by the Contracting Officer. This includes inadvertent spill of dirt, dust, or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, stop work immediately. Then clean up the spill. When satisfactory visual inspection and air sampling results are obtained, work may proceed at the discretion of the Contracting Officer.

### 3.2.2 Furnishings

Furniture and equipment will be removed from the area of work by the Government before asbestos work begins.

### 3.2.3 Precleaning

Wet wipe and HEPA vacuum all surfaces potentially contaminated with asbestos prior to establishment of an enclosure.

### 3.2.4 Asbestos Control Area Requirements

#### 3.2.4.1 Negative Pressure Enclosure

Block and seal openings in areas where the release of airborne asbestos fibers can be expected. Establish an asbestos negative pressure enclosure with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos work area. Negative pressure enclosure development shall include protective covering of uncontaminated walls, and ceilings with a continuous membrane of two layers of minimum 6-mil plastic sheet sealed with tape to prevent water or other damage. Provide two layers of 6-mil plastic sheet over floors and extend a minimum of 12 inches up walls. Seal all joints with tape. Provide local exhaust system in the asbestos control area. Openings will be allowed in enclosures of asbestos control areas for personnel and equipment entry and exit, the supply and exhaust of air for the local exhaust system and the removal of properly containerized asbestos containing materials. Replace local exhaust system filters as required to maintain the efficiency of the system.

### 3.2.5 Removal Procedures

Wet asbestos material with a fine spray of amended water during removal, or other handling so as to reduce the emission of airborne fibers. Remove material and immediately place in 6 mil plastic disposal bags. Remove asbestos containing material in a gradual manner, with continuous application of the amended water or wetting agent in such a manner that no asbestos material is disturbed prior to being adequately wetted. Where unusual circumstances prohibit the use of 6 mil plastic bags, submit an alternate proposal for containment of asbestos fibers to the Contracting Officer for approval. Asbestos containing material shall be containerized while wet. At no time shall asbestos material be allowed to accumulate or become dry. Lower and otherwise handle asbestos containing material as indicated in 40 CFR 61-SUBPART M.

### 3.2.6 Employee Exposure Air Sampling

Sampling of airborne concentrations of asbestos fibers shall be performed in accordance with 29 CFR 1926.1101 and as specified herein. Sampling performed in accordance with 29 CFR 1926.1101 shall be performed by the Contractor. Sampling performed for environmental and quality control reasons shall be performed by the Contracting Officer. Unless otherwise specified, use NIOSH Method 7400 for sampling and analysis. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those results obtained by the Contractor, the Government will determine which results predominate.

### 3.2.7 Lock-Down

Prior to removal of plastic barriers and after pre-clearance clean up of gross contamination, the Contracting Officer shall conduct a visual inspection of all areas affected by the removal. Inspect for any visible fibers. A post removal (lock-down) encapsulant shall then be spray applied to ceiling, walls, floors and other areas exposed in the removal area. The exposed area shall include but not be limited to plastic barriers, furnishings and articles to be discarded as well as dirty change room, air locks for bag removal and decontamination chambers.

### 3.2.8 Site Inspection

While performing asbestos engineering control work, the Contractor shall be subject to on-site inspection by the Contracting Officer who may be assisted by or represented by safety or industrial hygiene personnel. If the work is found to be in violation of this specification, the Contracting Officer or his representative will issue a stop work order to be in effect immediately and until the violation is resolved. All related costs including standby time required to resolve the violation shall be at the Contractor's expense.

## 3.3 CLEAN-UP AND DISPOSAL

### 3.3.1 Housekeeping

Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Use HEPA filtered vacuum cleaners. DO NOT BLOW DOWN THE SPACE WITH COMPRESSED AIR. When asbestos removal is complete, all asbestos waste is removed from the work-site, and final clean-up is completed, the Contracting Officer will attest that the area is safe before the signs can be removed. After final clean-up and acceptable airborne concentrations are attained but before the HEPA unit is turned off and the enclosure removed, remove all pre-filters on the building HVAC system and provide new pre-filters. Dispose of filters as asbestos contaminated materials. Reestablish HVAC mechanical, and electrical systems in proper working order. The Contracting Officer will visually inspect all surfaces within the enclosure for residual material or accumulated dust or debris. The Contractor shall re-clean all areas showing dust or residual materials. If re-cleaning is required, air sample and establish an acceptable asbestos airborne concentration after re-cleaning. The Contracting Officer must agree that the area is safe in writing before unrestricted entry will be permitted. The Government shall have the option to perform monitoring to

determine if the areas are safe before entry is permitted.

### 3.3.2 Title to Materials

All waste materials, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified in applicable local, State, and Federal regulations and herein.

### 3.3.3 Disposal of Asbestos

#### 3.3.3.1 Procedure for Disposal

Collect asbestos waste, asbestos contaminated water, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing which may produce airborne concentrations of asbestos fibers and place in sealed fiber-proof, waterproof, non-returnable containers (e.g. double plastic bags 6 mils thick, cartons, drums or cans). Wastes within the containers must be adequately wet in accordance with 40 CFR 61-SUBPART M. Affix a warning and Department of Transportation (DOT) label to each container including the bags or use at least 6 mils thick bags with the approved warnings and DOT labeling preprinted on the bag. The name of the waste generator and the location at which the waste was generated shall be clearly indicated on the outside of each container. Prevent contamination of the transport vehicle (especially if the transport vehicle is a rented truck likely to be used in the future for non-asbestos purposes). These precautions include lining the vehicle cargo area with plastic sheeting (similar to work area enclosure) and thorough cleaning of the cargo area after transport and unloading of asbestos debris is complete. Dispose of waste asbestos material at an Environmental Protection Agency (EPA) or State-approved asbestos landfill off Government property. For temporary storage, store sealed impermeable bags in asbestos waste drums or skids. An area for interim storage of asbestos waste-containing drums or skids will be assigned by the Contracting Officer or his authorized representative. Procedure for hauling and disposal shall comply with 40 CFR 61-SUBPART M, State, regional, and local standards. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the drum and the entire contaminated drum shall be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

#### 3.3.3.2 Asbestos Disposal Quantity Report

Contractor shall record and report, to the Contracting Officer, the amount of asbestos containing material removed and released for disposal. Deliver the report for the previous day at the beginning of each day shift with amounts of material removed during the previous day reported in linear feet or square feet as described initially in this specification and in cubic feet for the amount of asbestos containing material released for disposal.

-- End of Section --

SECTION 02 83 13.00 20

LEAD IN CONSTRUCTION

**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 INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z88.6 (2006) Respiratory Protection - Respirator Use-Physical Qualifications for Personnel

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

29 CFR 1926.103	Respiratory Protection
29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 745	Lead-Based Paint Poisoning Prevention in



Certain Residential Structures

49 CFR 172 Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

49 CFR 178 Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586 (2009; Reprint Sep 2014) Standard for High-Efficiency Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period.

1.2.2 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel (approximately 5 to 6 feet above the floor).

1.2.3 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.4 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.5 High Efficiency Particulate Arrestor (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.

1.2.6 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds.

1.2.7 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust

equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

#### 1.2.8 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

$$\text{PEL (micrograms/cubic meter of air)} = 400/\text{No. hrs worked per day}$$

#### 1.2.9 Material Containing Lead/Paint with Lead (MCL/PWL)

Any material, including paint, which contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint or MCL using laboratory instruments with specified limits of detection (usually 0.01 percent).

#### 1.2.10 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

#### 1.2.11 Physical Boundary

Area physically roped or partitioned off around lead control area to limit unauthorized entry of personnel.

### 1.3 DESCRIPTION

#### 1.3.1 Description of Work

Construction activities impacting PWL or material containing lead which are covered by this specification include the demolition and/or removal of material containing lead in poor condition, located as required to safely complete this project.

#### 1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

### 1.4 SUBMITTALS

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 the contract requirements:

SD-01 Preconstruction Submittals

Occupational and Environmental Assessment Data Report (if

objective data is used to justify excluding the initial occupational exposure assessment); G

Lead Compliance Plan including CP approval (signature, date, and certification number); G

Competent Person qualifications; G

Training Certification of workers and supervisors; G

lead waste management plan; G

written evidence that TSD is approved for lead disposal; G

Certification of Medical Examinations; G

#### SD-06 Test Reports

sampling results; G

Occupational and Environmental Assessment Data Report; G

#### SD-07 Certificates

Testing laboratory qualifications; G

Occupant Notification; G

Third party consultant qualifications; G

Clearance Certification; G

#### SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility; G

Waste turn-in documents or weight tickets for non-hazardous wastes that are disposed of at sanitary or construction and demolition landfills; G

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Qualifications

##### 1.5.1.1 Competent Person (CP)

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide documented construction project-related experience with implementation of OSHA's Lead in Construction standard (29 CFR 1926.62) which shows ability to assess occupational and environmental exposure to lead, experience with the use of respirators, personal protective equipment and other exposure reduction methods to protect employee health. Submit proper documentation that the CP is trained and licensed and certified in accordance with federal, State and local laws. The competent person shall be a licensed lead-based paint abatement Supervisor/Project Designer in the State of Hawaii.

#### 1.5.1.2 Training Certification

Submit a certificate for each worker and supervisor, signed and dated by the training provider, stating that the employee has received the required lead training specified in 29 CFR 1926.62(1) .

#### 1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air analysis, testing, and reporting of airborne concentrations of lead. Use a laboratory that is a successful participant in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis.

#### 1.5.1.4 Third Party Consultant Qualifications

Submit the name, address and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

#### 1.5.2 Requirements

##### 1.5.2.1 Competent Person (CP) Responsibilities

- a. Verify training meets all federal, State, and local requirements.
- b. Review and approve Lead Compliance Plan for conformance to the applicable referenced standards.
- c. Continuously inspect PWL or MCL work for conformance with the approved plan.
- d. Perform (or oversee performance of) air sampling. Recommend upgrades or downgrades (whichever is appropriate based on exposure) on the use of PPE (respirators included) and engineering controls.
- e. Ensure work is performed in strict accordance with specifications at all times.
- f. Control work to prevent hazardous exposure to human beings and to the environment at all times.
- g. Supervise final cleaning of the lead control area, take clearance wipe samples if necessary; review clearance sample results and make recommendations for further cleaning.
- h. Certify the conditions of the work as called for elsewhere in this specification.

##### 1.5.2.2 Lead Compliance Plan

Submit a detailed job-specific plan of the work procedures to be used in the disturbance of PWL or MCL. The plan shall include a sketch showing the location, size, and details of lead control areas, critical barriers, physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of

equipment and materials, work practices, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking, hygiene facilities and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and dust containing lead and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside of the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training and strategy, sampling and analysis strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multicontractor worksites to inform affected employees and to clarify responsibilities to control exposures.

The plan shall be developed by a certified planner/project designer in the State of Hawaii.

In occupied buildings, the plan shall also include an occupant protection program that describes the measures that will be taken during the work to notify and protect the building occupants.

#### 1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Compliance Plan.

- a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.
- b. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

#### 1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62 and 29 CFR 1926.103. Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62. Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

#### 1.5.2.5 Training

Train each employee performing work that disturbs lead, who performs MCL/PWL disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

#### 1.5.2.6 Respiratory Protection Program

- a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.
- b. Establish and implement a respiratory protection program as required by AIHA Z88.6, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

#### 1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

#### 1.5.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations. and address:

- a. Identification and classification of wastes associated with the work.
- b. Estimated quantities of wastes to be generated and disposed of.
- c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of USEPA hazardous waste permits manifests and USEPA Identification numbers.
- d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.
- e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
- f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.
- g. Work plan and schedule for waste containment, removal and disposal. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Wastes shall be cleaned up and containerized daily.
- h. Include any process that may alter or treat waste rendering a hazardous waste non hazardous.
- i. Unit cost for hazardous waste disposal according to this plan.

#### 1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, State, and local authorities regarding lead. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

#### 1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the Lead Waste Management Plan and the Lead Compliance Plan, including procedures and precautions for the work.

### 1.6 EQUIPMENT

#### 1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust, fume and mist. Respirators shall comply with the requirements of 29 CFR 1926.62.

#### 1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, eye, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

#### 1.6.3 Rental Equipment Notification

If rental equipment is to be used during PWL or MCL handling and disposal, notify the rental agency in writing concerning the intended use of the equipment.

#### 1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

#### 1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with four complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the lead removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, eye, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

### 1.7 PROJECT/SITE CONDITIONS

#### 1.7.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent areas. Where

existing work is damaged or contaminated, restore work to its original condition or better as determined by the Contracting Officer.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

### 3.1 PREPARATION

#### 3.1.1 Protection

##### 3.1.1.1 Notification

a. Notify the Contracting Officer 20 days prior to the start of any lead work.

b. Occupant Notification

Submit occupant written acknowledgment of the delivery of lead hazard information pamphlet (EPA 747-K-99-001 "Protect Your Family From Lead in Your Home") prior to commencing the renovation work for each affected unit using language provided in 40 CFR 745 Subpart E.

##### 3.1.1.2 Lead Control Area

a. Physical Boundary - Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside of the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

##### 3.1.1.3 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

##### 3.1.1.4 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

##### 3.1.1.5 Mechanical Ventilation System

a. To the extent feasible, use local exhaust ventilation or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

b. Vent local exhaust outside the building and away from building



ventilation intakes or ensure system is connected to HEPA filters.

#### 3.1.1.6 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

### 3.2 ERECTION

#### 3.2.1 Lead Control Area Requirements

Establish a lead control area by completely establishing barriers and physical boundaries around the area or structure where PWL or MCL removal operations will be performed.

### 3.3 APPLICATION

#### 3.3.1 Lead Work

Perform lead work in accordance with approved Lead Compliance Plan. Use procedures and equipment required to limit occupational exposure and environmental contamination with lead when the work is performed in accordance with 29 CFR 1926.62 , and as specified herein. Dispose of all PWL or MCL and associated waste in compliance with federal, State, and local requirements.

#### 3.3.2 Paint with Lead or Material Containing Lead Removal

Manual or power sanding or grinding of lead surfaces or materials is not permitted unless tools are equipped with HEPA attachments or wet methods. The dry sanding or grinding of surfaces that contain lead is prohibited. Provide methodology for removing lead in the Lead Compliance Plan. Select lead removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris or waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this removal process in the Lead Compliance Plan.

##### 3.3.2.1 Paint with Lead or Material Containing Lead - Indoor Removal

Perform manual removal in the lead control areas using enclosures, barriers or containments . Collect residue debris for disposal in accordance with federal, State, and local requirements.

##### 3.3.2.2 Paint with Lead or Material Containing Lead - Outdoor Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the Lead Compliance Plan. The worksite preparation (barriers or containments) shall be job dependent and presented in the Lead Compliance Plan.

#### 3.3.3 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any

clothing or equipment worn in the control area:

- a. Vacuum all clothing before entering the contaminated change room.
- b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.
- c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing, move to an appropriate shower facility, shower.
- d. Change to clean clothes prior to leaving the clean clothes storage area.

### 3.4 FIELD QUALITY CONTROL

#### 3.4.1 Tests

##### 3.4.1.1 Air Sampling Employee Exposure

Conduct sampling for lead in accordance with 29 CFR 1926.62 and as specified herein.

- a. Collect personal air samples on employees who are anticipated to have the greatest risk of exposure. In addition, collect air samples on at least twenty-five percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.
- b. Submit results of air samples within 72 hours after the air samples are taken.

##### 3.4.1.2 Testing of Material Containing Lead Residue

Test residue in accordance with 40 CFR 261 for hazardous waste.

### 3.5 CLEANING AND DISPOSAL

#### 3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the Lead Compliance Plan. Reclean areas showing dust or debris. After visible dust and debris is removed, wet wipe and HEPA vacuum all surfaces in the controlled area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before clearance testing.

##### 3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with

29 CFR 1926.62; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

Clear the lead control area in industrial facilities of all visible dust and debris.

For exterior work, soil samples taken at the exterior of the work site shall be used to determine if soil lead levels had increased at a statistically significant level (significant at the 95 percent confidence limit) from the soil lead levels prior to the operation. If soil lead levels either show a statistically significant increase above soil lead levels prior to work or soil lead levels above any applicable federal or state standard for lead in soil, the soil shall be remediated.

### 3.5.2 Disposal

- a. All material, whether hazardous or non-hazardous shall be disposed in accordance with all laws and provisions and all federal, State or local regulations. Ensure all waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.
- b. Contractor is responsible for segregation of waste. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261.
- c. Dispose of lead-contaminated material classified as hazardous waste at an EPA approved hazardous waste treatment, storage, or disposal facility off Government property.
- d. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. For hazardous waste, the collection drum requires marking/labeling in accordance with 40 CFR 262 during the accumulation/collection timeframe. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.
- e. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

#### 3.5.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility. Provide turn-in documents

or weight tickets for non-hazardous waste disposal.

#### 3.5.2.2 Payment for Hazardous Waste

Payment for disposal of hazardous and non-hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials or non-hazardous waste delivered is returned and a copy is furnished to the Government.

-- End of Section --

SECTION 02 84 16

HANDLING OF LIGHTING BALLASTS AND LAMPS CONTAINING PCBs AND MERCURY  
04/06

PART 1 GENERAL

1.1 REFERENCES

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

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

29 CFR 1910.1000	Air Contaminants
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 273	Standards For Universal Waste Management
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 178	Specifications for Packagings

1.2 REQUIREMENTS

Removal and disposal of PCB containing lighting ballasts and associated mercury-containing lamps. Contractor may encounter leaking PCB ballasts.

### 1.3 DEFINITIONS

#### 1.3.1 Certified Industrial Hygienist (CIH)

A industrial hygienist hired by the contractor shall be certified by the American Board of Industrial Hygiene.

#### 1.3.2 Leak

Leak or leaking means any instance in which a PCB article, PCB container, or PCB equipment has any PCBs on any portion of its external surface.

#### 1.3.3 Lamps

Lamp, also referred to as "universal waste lamp", is defined as the bulb or tube portion of an electric lighting device. A lamp is specifically designed to produce radiant energy, most often in the ultraviolet, visible, and infra-red regions of the electromagnetic spectrum. Examples of common universal waste electric lamps include, but are not limited to, fluorescent, high intensity discharge, neon, mercury vapor, high pressure sodium, and metal halide lamps.

#### 1.3.4 Polychlorinated Biphenyls (PCBs)

PCBs as used in this specification shall mean the same as PCBs, PCB containing lighting ballast, and PCB container, as defined in 40 CFR 761, Section 3, Definitions.

#### 1.3.5 Spill

Spill means both intentional and unintentional spills, leaks, and other uncontrolled discharges when the release results in any quantity of PCBs running off or about to run off the external surface of the equipment or other PCB source, as well as the contamination resulting from those releases.

#### 1.3.6 Universal Waste

Universal Waste means any of the following hazardous wastes that are managed under the universal waste requirements 40 CFR 273:

- (1) Batteries as described in Sec. 273.2 of this chapter;
- (2) Pesticides as described in Sec. 273.3 of this chapter;
- (3) Thermostats as described in Sec. 273.4 of this chapter; and
- (4) Lamps as described in Sec. 273.5 of this chapter.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Regulatory Requirements

Perform PCB related work in accordance with 40 CFR 761. Perform mercury-containing lamps storage and transport in accordance with 40 CFR 261, 40 CFR 264, 40 CFR 265, 40 CFR 273.

#### 1.4.2 Training

Certified industrial hygienist (CIH) shall instruct and certify the training of all persons involved in the removal of PCB containing lighting ballasts and mercury-containing lamps. The instruction shall include: The dangers of PCB and mercury exposure, decontamination, safe work practices,

and applicable OSHA and EPA regulations. The CIH shall review and approve the PCB and Mercury-Containing Lamp Removal Work Plans.

#### 1.4.3 Regulation Documents

Maintain at all times one copy each at the office and one copy each in view at the job site of 29 CFR 1910.1000, 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 265, 40 CFR 268, 40 CFR 270, 40 CFR 273 and of the Contractor removal work plan and disposal plan for PCB and for associated mercury-containing lamps.

#### 1.5 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 contract documents:

##### SD-07 Certificates

Qualifications of CIH; G

Training Certification; G

PCB and Lamp Removal Work Plan; G

PCB and Lamp Disposal Plan; G

##### SD-11 Closeout Submittals

Transporter certification of notification to EPA of their PCB waste activities and EPA ID numbers; G

##### Certification of Decontamination

Certificate of Disposal and/or recycling. Submit to the Government before application for payment within 30 days of the date that the disposal of the PCB and mercury-containing lamp waste identified on the manifest was completed.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

Use special clothing:

- a. Disposable gloves (polyethylene)
- b. Eye protection
- c. PPE as required by CIH

#### 1.7 SCHEDULING

Notify the Contracting Officer 20 days prior to the start of PCB and mercury-containing lamp removal work.

#### 1.8 QUALITY ASSURANCE

##### 1.8.1 Qualifications of CIH

Submit the name, address, and telephone number of the Industrial Hygienist

selected to perform the duties in paragraph entitled "Certified Industrial Hygienist." Submit training certification that the Industrial Hygienist is certified, including certification number and date of certification or re certification.

#### 1.8.2 PCB and Lamp Removal Work Plan

Submit a job-specific plan within 20 calendar days after award of contract of the work procedures to be used in the removal, packaging, and storage of PCB-containing lighting ballasts and associated mercury-containing lamps. Include in the plan: Requirements for Personal Protective Equipment (PPE), spill cleanup procedures and equipment, eating, smoking and restroom procedures. The plan shall be approved and signed by the Certified Industrial Hygienist. Obtain approval of the plan by the Contracting Officer prior to the start of PCB and/or lamp removal work.

#### 1.8.3 PCB and Lamp Disposal Plan

Submit a PCB and lamp Disposal Plan with 45 calendar days after award of contract. The PCB and Lamp Disposal Plan shall comply with applicable requirements of federal, state, and local PCB and Universal waste regulations and address:

- a. Estimated quantities of wastes to be generated, disposed of, and recycled.
- b. Names and qualifications of each Contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location. Furnish two copies of EPA and state PCB and mercury-containing lamp waste permit applications and EPA identification numbers, as required.
- c. Names and qualifications (experience and training) of personnel who will be working on-site with PCB and mercury-containing lamp wastes.
- d. Spill prevention, containment, and cleanup contingency measures to be implemented.
- e. Work plan and schedule for PCB and mercury-containing lamp waste removal, containment, storage, transportation, disposal and or recycling. Wastes shall be cleaned up and containerize daily.

### PART 2 PRODUCTS

Not used.

### PART 3 EXECUTION

#### 3.1 WORK PROCEDURE

Furnish labor, materials, services, and equipment necessary for the removal of PCB containing lighting ballasts, associated mercury-containing fluorescent lamps, in accordance with local, state, or federal regulations. Do not expose PCBs to open flames or other high temperature sources since toxic decomposition by-products may be produced. Do not break mercury containing fluorescent lamps or high intensity discharge lamps.



### 3.1.1 Work Operations

Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with 40 CFR 761, 40 CFR 262 40 CFR 263, and the applicable requirements of this section, including but not limited to:

- a. Obtaining suitable PCB and mercury-containing lamp storage sites.
- b. Notifying Contracting Officer prior to commencing the operation.
- c. Reporting leaks and spills to the Contracting Officer.
- d. Cleaning up spills.
- e. Inspecting PCB and PCB-contaminated items and waste containers for leaks and forwarding copies of inspection reports to the Contracting Officer.
- f. Maintaining inspection, inventory and spill records.

### 3.2 PCB SPILL CLEANUP REQUIREMENTS

#### 3.2.1 PCB Spills

Immediately report to the Contracting Officer any PCB spills.

#### 3.2.2 PCB Spill Control Area

Rope off an area around the edges of a PCB leak or spill and post a "PCB Spill Authorized Personnel Only" caution sign. Immediately transfer leaking items to a drip pan or other container.

#### 3.2.3 PCB Spill Cleanup

40 CFR 761, subpart G. Initiate cleanup of spills as soon as possible, but no later than 24 hours of its discovery. Mop up the liquid with rags or other conventional absorbent. The spent absorbent shall be properly contained and disposed of as solid PCB waste.

#### 3.2.4 Records and Certification

Document the cleanup with records of decontamination in accordance with 40 CFR 761, Section 125, Requirements for PCB Spill Cleanup. Provide test results of cleanup and certification of decontamination.

### 3.3 REMOVAL

#### 3.3.1 Ballasts

As ballast are removed from the lighting fixture, inspect label on ballast. Ballasts without a "No PCB" label shall be assumed to contain PCBs and containerized and disposed of as required under paragraphs STORAGE FOR DISPOSAL and DISPOSAL. If there are less than 1600 "No PCB" labeled lighting ballasts dispose of them as normal demolition debris.

#### 3.3.2 Lighting Lamps

Remove lighting tubes/lamps from the lighting fixture and carefully place

(unbroken) into appropriate containers (original transport boxes or equivalent). In the event of a lighting tube/lamp breaking, sweep and place waste in double plastic taped bags and dispose of as universal waste as specified herein.

### 3.4 STORAGE FOR DISPOSAL

#### 3.4.1 Storage Containers for PCBs

49 CFR 178. Store PCB in containers approved by DOT for PCB.

#### 3.4.2 Storage Containers for lamps

Store mercury containing lamps in appropriate DOT containers. The boxes shall be stored and labeled for transport in accordance with 40 CFR 273.

#### 3.4.3 Labeling of Waste Containers

Label with the following:

- a. Date the item was placed in storage and the name of the cognizant activity/building.
- b. "Caution Contains PCB," conforming to 40 CFR 761, CFR Subpart C. Affix labels to PCB waste containers.
- c. Label mercury-containing lamp waste in accordance with 40 CFR 273. Affix labels to all lighting waste containers.

### 3.5 DISPOSAL

Dispose of off Government property in accordance with EPA, DOT, and local regulations at a permitted site.

#### 3.5.1 Identification Number

Federal regulations 40 CFR 761, and 40 CFR 263 require that generators, transporters, commercial storers, and disposers of PCB waste possess U.S. EPA identification numbers. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Uniform Hazardous Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work. For mercury containing lamp removal, Federal regulations 40 CFR 273 require that large quantity handlers of Universal waste (LQHUW) must provide notification of universal waste management to the appropriate EPA Region (or state director in authorized states), obtain an EPA identification number, and retain for three years records of off-site shipments of universal waste. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Universal Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work.

#### 3.5.2 Transporter Certification

Comply with disposal and transportation requirements outlined in 40 CFR 761 and 40 CFR 263. Before transporting the PCB waste, sign and date the manifest acknowledging acceptance of the PCB waste from the Government. Return a signed copy to the Government before leaving the job site. Ensure

that the manifest accompanies the PCB waste at all times. Submit transporter certification of notification to EPA of their PCB waste activities (EPA Form 7710-53).

3.5.2.1 Certificate of Disposal and/or Recycling

40 CFR 761. Certificate for the PCBs and PCB items disposed shall include:

- a. The identity of the disposal and or recycling facility, by name, address, and EPA identification number.
- b. The identity of the PCB waste affected by the Certificate of Disposal including reference to the manifest number for the shipment.
- c. A statement certifying the fact of disposal and or recycling of the identified PCB waste, including the date(s) of disposal, and identifying the disposal process used.
- d. A certification as defined in 40 CFR 761.

-- End of Section --

SECTION 06 05 73

WOOD TREATMENT  
09/15

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C9	(2003) Plywood - Preservative Treatment by Pressure Processes
AWPA C31	(2000) Lumber Used out of Contact with the Ground and Continuously Protected from Liquid Water-Treatment by Pressure Processes
AWPA M4	(2011) Standard for the Care of Preservative-Treated Wood Products

1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

- SD-03 Product Data
  - Treating Solution
- SD-07 Certificates
  - Contractor Certificate
  - Preserver Certification
- SD-11 Closeout Submittals
  - Warranty

1.3 QUALITY CONTROL

1.3.1 Regulatory Requirements

Comply with State OSHL (Occupancy Safety and Health Law) and pollution controls regulations of the State Department of Health and EPA.

1.3.2 Qualifications

- a. Source Limitations for Treated Wood: Obtain each type of

fire-retardant-treated wood product through one source from a single producer.

b. Treatment methods shall be approved by ICBO. Preservatives shall be EPA registered.

c. Do not use preservatives containing arsenic or other EPA banned chemicals.

d. Do not use Perma-Clear 65 or other zinc naphthanate and permethrin products.

#### 1.3.3 Treated Wood

a. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

b. Exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece, or omit marking and provide certificates of treatment compliance issued by inspection agency.

#### 1.3.4 Preserver Certification

Provide a Certificate of Treatment showing compliance with these specifications for the following:

a. Kiln drying.

b. Method of treatment performed, including dip treatment.

#### 1.3.5 Contractor Certificate

Provide a certification letter stating that all wood used on this job including cuts and penetration were treated and coated with preservatives in compliance with requirements of this contract.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Protect AWPA C31 inorganic boron treated wood from contact with the ground, rain or other sources of liquid water until permanent installation of covering construction.

#### 1.5 WARRANTY

a. Provide a two year warranty to replace all treated wood which is attacked by subterranean termites up to a total cost of \$20,000.00 over the guaranty period (as verified by General Conditions Force Account Method cost accounting).

b. Provide a five year warranty to replace all treated wood which is attacked by dry wood termites or deteriorates due to dry rot. The Surety shall not be held liable beyond two years of the project acceptance date.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements

2.2 GENERAL

Mill lumber to finish size and shape prior to treating, and treat before assembly. Plywood may be treated in regular panel sizes.

2.3 Restricted Treatment

Preservative-treated lumber with chromated copper arsenate (CCA) treatments is not permitted, and lumber with copper-based treatments (such as ACQ) is permitted only for ground-contact applications.

2.4 PRESSURE TREATMENT WITH WATER-BORNE PRESERVATIVES

2.4.1 Treating Solution:

- a. Copper azole, Type A (CBA-A).
- b. Inorganic boron (SBX)

2.4.2 Treatment Methods

All water-borne treatment methods require incising of lumber of nominal 2 inch thickness (1-1/2 inches actual dimension).

- a. CBA-A: Treatment methods, depth of penetration and treating solution retention shall conform to AWPA C2 for lumber and AWPA C9 for plywood.
- b. SBX: Treatment method shall conform to AWPA C31. Treating solution retention shall be a minimum of 0.28 pounds per cubic foot (equivalent to 0.42 DOT).

2.4.3 Drying

Before Treatment:

- a. CBA-A Treatment: Wood shall be air dried or kiln-dried before treatment to an average moisture content of 28 percent or less per AWPA standards.
- b. SBX Treatment: Wood having a moisture content higher than 28% is acceptable when treating with SBX.

After Treatment: All 1 inch and 2 inch lumber and all plywood shall be dried to a moisture content of 19 percent or less after treatment.

2.5 PRESSURE TREATMENT WITH OIL-BORNE PRESERVATIVES

2.5.1 Treating Solution:

- a. 0.50 percent by weight chlorpyrifos, 0.75 percent by weight 3-iodo-2-propynyl butyl carbamate (IPBC). The solvent used in

formulating the preservative solution shall meet the requirements of AWPA hydrocarbon solvent Type C, Standard P9, Paragraph 3.1.

b. For interior application use low odor mineral spirits as solvent.

#### 2.5.2 Treatment Methods:

Treated wood shall attain the following net retention requirements: 0.0175 pounds of Chlorpyrifos per cubic foot of wood, 0.035 pound of 3-Iodo-2 propynyl butyl carbamate per cubic foot of wood.

#### 2.5.3 Drying

a. Before Treatment: All wood treated with oil-borne preservatives shall be kiln-dried to an average moisture content of 12% to 15% per AWPA standards.

b. After Treatment: Wood shall be thoroughly dried and virtually odor-free prior to installation.

### 2.6 PRESERVATION BY DIP TREATMENT

#### 2.6.1 Treating Solution:

a. Any of the Oil-Borne Preservatives listed above.

b. A solution of 1 quart chlopyrifos in 55 gallons of a 0.50 percent IPBC solution.

#### 2.6.2 Treatment Methods:

a. Immersion treat for a minimum period of 15 minutes. Hollow-core flush wood doors shall be immersion treated for a period of 5 minutes.

b. Do not incise lumber scheduled to be left unpainted or receive a clear finish.

#### 2.6.3 Drying

After Treatment: Wood shall be thoroughly dried and virtually odor-free prior to installation.

### 2.7 FIELD TREATMENT

Treat in accordance with AWPA M4 using two heavy brush coats of a treating solution.

## PART 3 EXECUTION

### 3.1 GENERAL

a. Treat all wood species except all-heart redwood.

b. All water-borne and oil-borne treatment solutions are applicable to douglas-fir and hem-fir species except for CBA-A treatment which is acceptable for hem-fir species only.

### 3.2 PRESSURE TREATMENT

- a. General: Unless otherwise stipulated, all lumber and plywood shall be pressure treated.
- b. Hardwood flooring and exposed lumber 1-1/2" (net thickness) and over that will be unpainted or receive a clear finish shall be and pressure treated with oil-borne preservative. Do not incise lumber.
- c. SBX treated wood shall not be used in areas exposed to direct precipitation (e.g. exposed decking, trellises, fencing, etc.) unless painted or covered with a finish material.

### 3.3 DIP TREATMENT

All finish lumber under 1-1/2 inch net thickness (except hardwood flooring); doors (solid wood and solid-core flush wood doors); finish plywood; and mill work items, such as for cabinet work, shelving and similar wood work that will be exposed to view in the finished work.

### 3.4 FIELD CUTS

Treat end cuts, notches and penetrations into treated lumber or plywood. Exception: Cuts and penetrations made in SBX treated wood 2 inches or less in nominal thickness need not be field treated.

-- End of Section --



SECTION 06 20 00

FINISH 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 LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20 (2010) American Softwood Lumber Standard

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA L870 (2010) Voluntary Product Standard, PS  
1-09, Structural Plywood

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI AWS (2009) Architectural Woodwork Standards

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts  
and Screws (Inch Series)

ASME B18.2.2 (2010) Nuts for General Applications:  
Machine Screw Nuts, Hex, Square, Hex  
Flange, and Coupling Nuts (Inch Series)

ASME B18.6.1 (1981; R 2008) Wood Screws (Inch Series)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (2004) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 (2011) Western Lumber Grading Rules

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver lumber, plywood, trim, and millwork to job site in an undamaged condition. Stack materials to ensure ventilation and drainage. Protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in building until wet trade materials are dry.

### 1.3 QUALITY ASSURANCE

#### 1.3.1 Lumber

Identify each piece or each bundle of lumber, millwork, and trim by the grade mark of a recognized association or independent inspection agency that is certified by the Board of Review, American Lumber Standards Committee, to grade the species.

#### 1.3.2 Plywood

Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of the plywood. Mark shall identify plywood by species group or span rating, and shall show exposure durability classification, grade, and compliance with APA L870.

#### 1.3.3 Treated Lumber and Plywood

Treat wood in accordance with Section 06 05 73

#### 1.3.4 Fire-Retardant Treated Lumber

Each piece to bear Underwriters Laboratories label or the label of another nationally recognized independent testing laboratory.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements

### 2.2 WOOD

#### 2.2.1 Sizes and Patterns of Wood Products

Yard and board lumber sizes shall conform to ALSC PS 20. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the applicable standard.

#### 2.2.2 Trim, Finish, and Frames

Provide species and grades listed for materials to be paint finished. Run trim, except window stools and aprons with hollow backs.

<u>TABLE OF GRADES FOR WOOD TO RECEIVE PAINT FINISH</u>		
<u>Grading Rules</u>	<u>Species</u>	<u>Exterior and Interior Trim, Finish, and Frames</u>
WWPA G-5 standard grading rules	Douglas Fir-Larch, Hem-Fir,	All Species: C & Btr. Select or Superior Finish. Western Red Cedar may be graded C & Btr. Select or A & Btr. per Special Western Red Cedar Rules.
WCLIB 17 standard grading rules	Douglas Fir-Larch, Hem-Fir,	All Species: C & Btr VG, except A for Western Red Cedar

### 2.2.3 Salvaged Wood

Prepare wood identified to be salvaged for reused by removing fasteners, hardware and stripping existing finish to expose wood to accomodate reuse and paint finish.

## 2.3 FASCIAS AND TRIM

### 2.3.1 Wood

Fascias and trim, including exterior door and window casing, shall be species and grade listed in this section. Sizes shall be as indicated.

## 2.4 HARDWARE

Provide sizes, types, and spacings of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified.

### 2.4.1 Wood Screws

ASME B18.6.1.

### 2.4.2 Bolts, Nuts, Lag Screws, and Studs

ASME B18.2.1 and ASME B18.2.2.

## 2.5 FABRICATION

### 2.5.1 Quality Standards (QS)

The terms "Premium," "Custom," and "Economy" refer to the quality grades defined in AWI AWS. Items not specified to be of a specific grade shall be Custom grade. The AWI QS is superseded by all contract document requirements indicated or stated herein.

### PART 3 EXECUTION

#### 3.1 FINISH WORK

Provide sizes, materials, and designs as indicated and as specified. Apply primer to finish work before installing. Where practicable, shop assemble and finish items of built-up millwork. Joints shall be tight and constructed in a manner to conceal shrinkage. Miter trim and moldings at exterior angles and cope at interior angles and at returns. Material shall show no warp after installation. Install millwork and trim in maximum practical lengths. Fasten finish work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping.

##### 3.1.1 Exterior Finish Work

Machine-sand exposed flat members and square edges. Machine-finish semi-exposed surfaces. Construct joints to exclude water. In addition to nailing, glue joints of built-up items with waterproof glue as necessary for weather-resistant construction. Provide well distributed end joints in built-up members. Provide shoulder joints in flat work. Hold backs of wide-faced miters together with metal rings and waterproof glue. Fascias and other flat members, unless otherwise indicated, shall be 3/4 inch thick. Provide door and window trim in single lengths. Provide braced, blocked, and rigidly anchored cornices for support and protection of vertical joints. Install soffits in largest practical size. Joints of plywood shall occur over center lines of supports. Back prime all concealed surfaces of exterior trim.

##### 3.1.2 Interior Finish Work

After installation, sand exposed surfaces smooth. Provide door trim in single lengths.

##### 3.1.3 Door Frames

Set plumb and square. Provide solid blocking at not more than 16 inches o.c. for each jamb. Position blocking to occur behind hinges and lock strikes. Double wedge frames and fasten with finishing nails. Set nails for putty stopping.

#### 3.2 EXTERIOR TRIM

Exposed surfaces and square edges shall be machine sanded, caulked, and constructed to exclude water. Joints of built-up items, in addition to nailing, shall be glued as necessary for weather-resistant construction. End joints in built-up members shall be well distributed. Joints in flat work shall be shouldered. Backs of wide-faced miters shall be held together with metal rings and glue. Fascias and other flat members shall be in maximum practicable lengths. Cornices shall be braced, blocked, and rigidly anchored for support and protection of vertical joints.

#### 3.3 MOLDING AND INTERIOR TRIM

Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent

practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

-- 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 E84	(2015a) Standard Test Method for Surface Burning Characteristics of Building Materials

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

29 CFR 1910.134	Respiratory Protection
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1.2 SUBMITTALS

Submit the following in accordance with the contract documents.

SD-03 Product Data

Blanket Insulation

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 Other Safety Concerns

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

### PART 2 PRODUCTS

#### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements

#### 2.2 BLANKET INSULATION

ASTM C665, Type II, blankets with non-reflecting coverings ; Class A, membrane-faced surface with a flame spread of 25 or less , except a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

##### 2.2.1 Thermal Resistance Value (R-VALUE)

The R-Value must be as indicated on drawings.

##### 2.2.2 Prohibited Materials

Do not provide asbestos-containing materials.

##### 2.2.3 Reduced Volatile Organic Compounds (VOC) for Insulation Materials

Contain no formaldehyde based binders or shall be third-party certified for Indoor Air Quality with Greenguard Children & Schools or SCS Indoor Advantage Gold

#### 2.3 ACCESSORIES

##### 2.3.1 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

##### 2.3.2 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

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

3.2 PREPARATION

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Any materials that show visual evidence of biological growth due to presence of moisture must not be installed on the building project. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.3.1.1 Electrical wiring

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

3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Where insulation required is thicker than depth of joist, provide full width blankets to cover across top of joists. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.3.1.3 Installation at Bridging and Cross Bracing

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

3.3.1.4 Sizing of Blankets

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

3.3.1.5 Special Requirements for Ceilings

Place insulation under electrical wiring occurring across joists. Pack insulation into narrowly spaced framing. Do not block flow of air through soffit vents.

-- End of Section --



SECTION 07 84 00

FIRESTOPPING  
05/10

PART 1 GENERAL

1.1 SUMMARY

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

- a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.
- b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.
- c. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E814 (2013a) Standard Test Method for Fire Tests of Through-Penetration Fire Stops

ASTM E84 (2015a) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4991 (2013) Approval of Firestop Contractors

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

UNDERWRITERS LABORATORIES (UL)

UL 1479 (2003; Reprint Oct 2012) Fire Tests of Through-Penetration Firestops

UL 723 (2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials

UL Fire Resistance

(2014) Fire Resistance Directory

### 1.3 SEQUENCING

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

### 1.4 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-02 Shop Drawings

Firestopping System

SD-03 Product Data

Firestopping Materials

### 1.5 QUALITY ASSURANCE

#### 1.5.1 Installer

Engage an experienced Installer who is one of the following:

- a. FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor, or
- b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training, and retain proof of certification for duration of firestop installation.

### 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements

### 2.2 FIRESTOPPING SYSTEM

Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal must indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

Also, submit a written report indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL list printed numbers.

### 2.3 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

#### 2.3.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

#### 2.3.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

#### 2.3.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

##### 2.3.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph

SYSTEM DESCRIPTION, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Fire resistance ratings shall be as indicated.

#### 2.3.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with UL 1479.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Areas to receive firestopping must be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement must be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

#### 3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

##### 3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

##### 3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. Firestop installed

with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

-- 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 C734	(2006; R 2012) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C919	(2012) Use of Sealants in Acoustical Applications
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D217	(2010) Cone Penetration of Lubricating Grease
ASTM E84	(2015a) Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

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-04 Samples

Color Scamples or charts of manufacturer standard colors

1.3 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

#### 1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

#### 1.5 QUALITY ASSURANCE

##### 1.5.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

##### 1.5.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

#### 1.6 SPECIAL WARRANTY

Guarantee sealant joint against failure of sealant and against water penetration through each sealed joint for five years.

### PART 2 PRODUCTS

#### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### 2.2 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

##### 2.2.1 Interior Sealant

Provide ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) and color(s) of sealant for the following:

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	As selected
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	As selected

LOCATION	COLOR
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	As selected
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	As selected
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected

### 2.2.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color
b. Voids where items pass through exterior walls.	Match adjacent surface color
c. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match adjacent surface color
d. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color

### 2.2.3 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.

### 2.3 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.



## 2.4 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.

## 2.5 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.

## 2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer.

# 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 or stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
over 1/2 inch to 2 inch	1/2 inch	5/8 inch
Over 2 inch	As recommended by sealant manufacturer	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

#### 3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

#### 3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

- a. Where indicated.
- b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

#### 3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to

joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

### 3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

### 3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

## 3.4 PROTECTION AND CLEANING

### 3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

### 3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.
- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES

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 (2015) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M (2015) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A879/A879M (2012) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

ASTM A924/A924M (2014) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115 (2014) 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 (2016) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111 (2009) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories

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; Reprint Feb 2015) Standard for  
Positive Pressure Fire Tests of Door  
Assemblies

1.2 SUBMITTALS

Submit the following in accordance with contract documents:

SD-02 Shop Drawings

Doors

Frames

Submit door and frame locations.

SD-03 Product Data

Doors

Frames

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knock-down frames in bundles. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 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 doors , of size(s) and design(s) indicated.

## 2.2 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 2 , except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners. Provide steel frames for doors, transoms, sidelights, cased openings, and interior glazed panels, unless otherwise indicated.

### 2.2.1 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.

### 2.2.2 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.

### 2.2.3 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto or knock-down for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

### 2.2.4 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

### 2.2.5 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

### 2.2.6 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.

#### 2.2.6.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for

each additional 2.5 feet or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to wood studs with nails, to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;
- c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and
- d. Solid plaster partitions: Secure anchors solidly to back of frames and tie into the lath. Provide adjustable top strut anchors on each side of frame for fastening to structural members or ceiling construction above. Size and type of strut anchors shall be as recommended by the frame manufacturer.

#### 2.2.6.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

### 2.3 FIRE DOORS AND FRAMES

NFPA 80 and this specification. The requirements of NFPA 80 shall take precedence over details indicated or specified.

#### 2.3.1 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.

#### 2.3.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

#### 2.3.3 Astragal on Fire Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements.

### 2.4 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

### 2.5 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 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.

## 2.6 FINISHES

### 2.6.1 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924M and ASTM A653/A653M. The coating weight shall meet or exceed the minimum requirements for coatings having 0.6 ounces per square foot, total both sides, i.e., A60. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8. .

### 2.6.2 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.

## 2.7 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.

### 2.7.1 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.

## 2.8 PROVISIONS FOR GLAZING

Materials are specified in Section 08 81 00, GLAZING.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. Coat



inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

### 3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection 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. Install fire rated smoke doors and frames 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.

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

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

WDMA I.S.4 (2013) Preservative Treatment for Millwork

1.2 SUBMITTALS

Submit the following in accordance with contract documents.

SD-02 Shop Drawings

Doors

Submit drawings or catalog data showing each type of door unit. Drawings and data shall indicate door type and construction, sizes and thickness.

SD-03 Product Data

Doors

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inch thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

1.4 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements

identified in Section 01 81 13 Sustainable Design Requirements.

## 2.2 DOORS

Provide doors of the types, sizes, and designs indicated free of urea-formaldehyde resins.

### 2.2.1 Flush Doors

Conform to ANSI/WDMA I.S.1A for flush doors. Provide hollow core doors with lock blocks and 1 inch minimum thickness hinge stile. Hardwood stile edge bands of doors receives a natural finish, compatible with face veneer. Provide mill option for stile edge of doors scheduled to be painted. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.

#### 2.2.1.1 Interior Flush Doors

Provide hollow core, Type II flush doors conforming to ANSI/WDMA I.S.1A with faces of sound grade hardwood or hardboard for painted finish .

## 2.3 FABRICATION

### 2.3.1 Marking

Stamp each door with a brand, stamp, or other identifying mark indicating quality and construction of the door.

### 2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based and identify doors having a Type I glue bond.

### 2.3.3 Preservative Treatment

Treat doors scheduled for restrooms, janitor closets and other possible wet locations including exterior doors with a water-repellent preservative treatment and so marketed at the manufacturer's plant in accordance with WDMA I.S.4.

### 2.3.4 Adhesives and Bonds

ANSI/WDMA I.S.1A. Use Type I bond for exterior doors and Type II bond for interior doors. Provide a nonstaining adhesive on doors with a natural finish.

### 2.3.5 Prefitting

Provide factory prefinished and factory prefitted doors for the specified hardware, door frame and door-swing indicated. Machine and size doors at the factory by the door manufacturer in accordance with the standards under which the doors are produced and manufactured. The work includes sizing, beveling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules to coordinate the work.

### 2.3.6 Finishes

#### 2.3.6.1 Field Painting

Factory prime or seal doors, and field paint.

#### 2.3.7 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finish.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/16 inch minimum, 1/4 inch maximum clearance over thresholds. Provide 3/8 inch minimum, 7/16 inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inch. Door warp shall not exceed 1/4 inch when measured in accordance with ANSI/WDMA I.S.1A.

-- End of Section --

SECTION 08 51 13

ALUMINUM WINDOWS

05/11

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA 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

AAMA/WDMA/CSA 101/I.S.2/A440 (2011) Standard/Specification for Windows, Doors, and Skylights

ASTM INTERNATIONAL (ASTM)

ASTM E1300 (2012a; E 2012) Determining Load Resistance of Glass in Buildings

ASTM F2248 (2012) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass

1.2 CERTIFICATION

Each prime window unit must bear the AAMA Label warranting that the product complies with AAMA/WDMA/CSA 101/I.S.2/A440. Certified test reports attesting that the prime window units meet the requirements of AAMA/WDMA/CSA 101/I.S.2/A440, including test size, will be acceptable in lieu of product labeling.

1.3 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-02 Shop Drawings

Windows

SD-03 Product Data

Windows

Hardware

SD-04 Samples

Finish Sample

SD-05 Design Data

Structural Calculations for Deflection

Design Analysis

Submit design analysis with calculations showing that the design of each different size and type of aluminum window unit and its anchorage to the structure meets the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered Professional Engineer. The window components and anchorage devices to the structure, as determined by the design analysis, must be reflected in the shop drawings.

#### 1.4 QUALITY ASSURANCE

##### 1.4.1 Shop Drawing Requirements

Provide drawings that indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, mullion details, method of attaching screens, installation details, and other related items. Provide detail drawings of existing historic window profiles and indicate differences with windows to be provided.

##### 1.4.2 Sample Requirements

###### 1.4.2.1 Finish Sample Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

##### 1.4.3 Design Data Requirements

Submit calculations to substantiate compliance with deflection requirements. A registered Professional Engineer must provide calculations.

Submit design analysis with calculations verifying the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the window components and anchorage devices to the structure, as determined by the design analysis, in the shop drawings.

#### 1.5 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite.

Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

#### 1.6 PROTECTION

Protect finished surfaces during shipping and handling using the manufacturer's standard method. Do not apply coatings or lacquers to surfaces to which caulking and glazing compounds must adhere.

#### 1.7 FIELD MEASUREMENTS

Take field measurements prior to preparation of the drawings and fabrication.

#### 1.8 PERFORMANCE AND DESIGN CRITERIA

##### 1.8.1 Wind Loading Design Pressure

Design window components, including mullions, hardware, and anchors, to withstand a wind-loading design pressure based on the following:

- a. Basic Wind Speed: 120 MPH.
- b. Importance Factor: II.
- c. Exposure Category: B.

##### 1.8.2 Design

Window appearance including frame, sash and other components shall closely match existing historic window profiles in size and shape.

#### 1.9 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete window assembly including hardware, weatherstripping, and subframe assembly details.

#### 1.10 WINDOW PERFORMANCE

Aluminum windows must meet the following performance requirements. Perform testing requirements by an independent testing laboratory or agency.

##### 1.10.1 Structural Performance

Structural test pressures on window units must be for positive load (inward) and negative load (outward). After testing, there will be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There must be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA/WDMA/CSA 101/I.S.2/A440 for the window types and classification specified in this section.

##### 1.10.2 Water Penetration

Water penetration must not exceed the amount established by

AAMA/WDMA/CSA 101/I.S.2/A440 for each window type.

#### 1.11 QUALIFICATION

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of five years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

#### 1.12 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

### PART 2 PRODUCTS

#### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### 2.2 WINDOWS

Provide prime windows that comply with AAMA/WDMA/CSA 101/I.S.2/A440 and the requirements specified herein. In addition to compliance with AAMA/WDMA/CSA 101/I.S.2/A440, window framing members for each individual light of glass must not deflect to the extent that deflection perpendicular to the glass light exceeds  $L/175$  of the glass edge length when subjected to uniform loads at specified design pressures. Provide Structural calculations for deflection to substantiate compliance with deflection requirements. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified. Design windows to accommodate hardware, glass, weatherstripping, screens, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum.

##### 2.2.1 Projected Windows (AP)

Type AP-AW40. Provide projected windows with concealed four bar friction hinges only.

##### 2.2.2 Fixed Windows (F)

Type F-AW40.

##### 2.2.3 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

##### 2.2.4 Caulking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

##### 2.2.5 Weatherstripping

AAMA/WDMA/CSA 101/I.S.2/A440.



## 2.3 FABRICATION

Fabrication of window units must comply with AAMA/WDMA/CSA 101/I.S.2/A440.

### 2.3.1 Provisions for Glazing

Design windows and rabbets suitable for glass thickness shown or specified.

### 2.3.2 Weatherstripping

Provide for ventilating sections of all windows to ensure a weather-tight seal meeting the infiltration requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440. Provide easily replaceable factory-applied weatherstripping. Use molded vinyl, molded or molded-expanded neoprene or molded or expanded Ethylene Propylene Diene Terpolymer (EPDM) compression-type weatherstripping for compression contact surfaces. Use treated woven pile or wool, or polypropylene or nylon pile bonded to nylon fabric and metal or plastic backing strip weatherstripping for sliding surfaces. Do not use neoprene or polyvinylchloride weatherstripping where exposed to direct sunlight.

### 2.3.3 Fasteners

Use window manufacturer's standard for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick.

### 2.3.4 Adhesives

Provide joint sealants as specified in Section 07 92 00 JOINT SEALANTS. For interior application of joint sealants, comply with applicable regulations regarding reduced VOC's, and as specified in Section 07 92 00 JOINT SEALANTS.

### 2.3.5 Drips and Weep Holes

Provide drips and weep holes as required to return water to the outside.

### 2.3.6 Combination Windows

Windows used in combination must be factory assembled of the same class and grade. Where factory assembly of individual windows into larger units is limited by transportation considerations, prefabricate, match mark, transport, and field assemble.

### 2.3.7 Mullions and Transom Bars

Provide mullions between multiple window units to resist two times (2X) glazing resistance in accordance with ASTM F2248 and ASTM E1300. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form a weathertight joint.

### 2.3.8 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation.

#### 2.3.8.1 Hardware

AAMA/WDMA/CSA 101/I.S.2/A440. The item, type, and functional characteristics must be the manufacturer's standard for the particular window type. Provide hardware of suitable design and of sufficient strength to perform the function for which it is used. Equip all operating ventilators with a lock or latching device which can be secured from the inside.

#### 2.3.8.2 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 6 inches from each end and at midpoint.

#### 2.3.8.3 Window Anchors

Anchoring devices for installing windows must be made of stainless steel conforming to AAMA/WDMA/CSA 101/I.S.2/A440.

#### 2.3.9 Finishes

Exposed aluminum surfaces must be factory finished with an anodic coating and organic coating. Organic coating color shall be selected from manufacturer's standard colors..

##### 2.3.9.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF45 and AAMA 611. Finish must be:

- b. Architectural Class I ( 0.7 mil or thicker), designation AA-M10-C22-A41, clear (natural) anodized.

##### 2.3.9.2 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 2604 with total dry film thickness of not less than 1.2 mils.

#### 2.3.10 Screens

AAMA/WDMA/CSA 101/I.S.2/A440. Provide one insect screen for each operable exterior sash or ventilator. Design screens to be rewirable, easily removable from inside the building, and to permit easy access to operating hardware.

#### 2.4 SPECIAL OPERATORS

For windows having operating hardware or locking or latching devices located more than 6 feet above the floor, provide suitably designed operators or locking or latching devices necessary for convenient and proper window operation.

##### 2.4.1 Pole Operators

Poles must be of proper length to permit window operation from 5 feet above

the floor. Provide one pole operator for each room, and one pole hanger for each pole. Locate hangers where directed.

#### 2.4.2 Extension Crank Operators

Provide removable handles for crank-operated rotary-type operators located more than 6 feet above the floor. Provide one removable handle for each room.

#### 2.5 WINDOWS

Provide thermal-barrier windows, complete with accessories and fittings, where indicated.

Specify material and construction except as follows:

- a. Aluminum alloy must be 6063-T6.
- b. Frame construction, including operable sash, must be factory-assembled and factory-sealed inner and outer aluminum completely separated from metal-to-metal contact. Join assembly by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner frame. Metal fasteners, straps, or anchors must not bridge the connection between the inner and outer frame.
- c. Operating hardware for each sash must consist of spring-loaded nylon cushion blocks and pin locks designed to lock in predetermined locations.
- d. Sash must be completely separated from metal-to-metal contact by means of woven-pile weatherstripping, plastic, or elastomeric separation members.
- e. Operating and storm sash must be factory-glazed with the type of glass indicated and of the quality specified in Section 08 81 00 GLAZING.

#### 2.6 MULLIONS

Provide mullions between multiple-window units where indicated.

Provide profiles for mullions and mullion covers, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion will include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly must include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover must be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members must be fabricated of the materials specified in AAMA/WDMA/CSA 101/I.S.2/A440 and meet the specified design loading.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

##### 3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surface from dissimilar materials as recommended in the Appendix to AAMA/WDMA/CSA 101/I.S.2/A440. Do not coat surfaces in contact with sealants after installation with any type of protective material.

##### 3.1.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in masonry walls must have head and jamb members designed to recess into masonry wall not less than 7/16 inch.

##### 3.1.4 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary. Verify that products are properly installed, connected, and adjusted.

#### 3.2 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

-- End of Section --

SECTION 08 51 23

STEEL WINDOWS

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.

ASME INTERNATIONAL (ASME)

ASME B18.6.3 (2013) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

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 A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-02 Shop Drawings

Windows

Indicate elevations of windows, full-size sections, thicknesses and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, other related items, and installation details.

SD-03 Product Data

Fasteners

SD-04 Samples

Color Coating

Submit factory finish standard colors for color selection.

1.3 DELIVERY AND STORAGE

Deliver to project site in undamaged condition. Store windows and components on edge, out of contact with the ground, under weathertight

covering, and arranged to avoid bending, warping, or other damage.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

### 2.2 MATERIALS

#### 2.2.1 General System Requirements

#### 2.2.2 Sheet Steel

ASTM A1011/A1011M.

#### 2.2.3 Zinc-Coated Sheet Steel

ASTM A653/A653M.

#### 2.2.4 Screws and Bolts

ASME B18.6.3 as applicable.

### 2.3 FABRICATION OF WINDOWS

Form permanent joints by welding as specified for each type window. Use joints of strength to maintain structural value of members connected. Weld joints solid, remove excess metal, and dress smooth on exposed and contact surfaces. Closely fit joints formed with mechanical fastenings and make permanently watertight. Assemble frames at the plant and ship as a unit with hardware unattached. Provide the following construction:

- a. Provide fixed sash of manufacturer's standard type suitable for the purpose.

Provide drips and weep holes as required to return water to outside.

- c. Design glazed windows and rabbets suitable for glass thickness shown on drawings or specified.
- d. Use flathead, cross recessed type, exposed head screws and bolts with standard threads on windows, trim and accessories. Screw heads must finish flush with adjoining surfaces. Self tapping sheet-metal screws are not acceptable.
- e. For windows with painted finish use cadmium plated or electro-galvanized fasteners. Finish exposed heads to match finish of windows.

### 2.4 FIRE RATED WINDOWS

Provide sash and frame with necessary hardware to conform to the requirements of Underwriters Laboratories Inc. (UL), for class of window indicated. Submit proof of conformance. UL label will be accepted as proof. Labeled window details take precedence over details indicated or specified for nonlabeled windows, except when sections required for nonlabeled windows are heavier than those required by UL. In lieu of UL

label, written certification by approved nationally recognized testing agency may be submitted. Certification must state that complete window unit of type provided has been tested and conforms to published standards, including methods of tests, of UL.

## 2.5 PROVISIONS FOR GLAZING

Design sash for glazing and for securing glass with metal beads or glazing clips and glazing compound.

## 2.6 MULLIONS AND TRANSOM BARS

Provide mullions between multiple window units. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form weathertight joint. Provide mullion covers of manufacturer's stock design on the interior and exterior to completely cover exposed joints and recesses between window units and for neat appearance.

## 2.7 METAL-TO-METAL JOINTS

Set in mastic, using type recommended by window manufacturer to provide weathertight joints. Remove excess mastic before it hardens.

## 2.8 ACCESSORIES

Provide windows with hardware, clips, fins, anchors, glazing beads, and fastenings, necessary for complete installation and operation of ventilators.

### 2.8.1 Anchors

Use hot-dip galvanized steel anchors. Secure anchors and fastenings to heads, jambs, and sills of openings, and fasten securely to windows or frames. Use anchors recommended by window manufacturer for specific type of construction and conceal. Anchor each frame at jambs with minimum of three adjustable steel anchors.

### 2.8.2 Fasteners

Stainless steel or aluminum materials; zinc-coated or cadmium plated steel. Prime exposed heads of coated or plated fasteners and finish to match adjacent material.

## 2.9 WINDOW FINISH

### 2.9.1 Factory Finish

Apply manufacturer's standard powder color coating finish system complying with AAMA 2603 applied to factory-assembled frames before shipping, complying with manufacturer's written instructions for surface preparation including pretreatment, application, and minimum dry film thickness.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install in accordance with window manufacturer's printed instructions and details. Build in windows as work progresses or install without forcing

into prepared window openings. Set at proper elevation, location, and reveal; plumb, square, level, and in alignment. Brace and stay to prevent distortion and misalignment. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant recommended by window manufacturer.

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

### 3.2 ANCHORS AND FASTENINGS

Make provision for securing units to each other and to adjoining construction. Space anchors not more than 18 inches apart on jambs and sills, and install a minimum of three anchors on each side of each opening. Anchors and fastenings must have sufficient strength to hold member firmly in position. Where type, size, or spacing of anchors is not shown or specified, use expansion or toggle bolts or screws as best suited to construction material. Provide expansion shield and bolt assemblies of type designed to give holding power beyond tensile and shearing strength of bolt. Minimum fastener penetration must be not less than that recommended by manufacturer for type fastener and wall material involved.

### 3.3 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance and to prevent fouling of weathering surfaces and weatherstripping, or interference with operation of hardware. Clean and touch up abraded surfaces. Replace with new windows any stained, discolored, or abraded windows that cannot be restored to original condition.

-- 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.

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2013) Butts and Hinges
ANSI/BHMA A156.13	(2012) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16	(2013) Auxiliary Hardware
ANSI/BHMA A156.2	(2011) Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21	(2014) Thresholds
ANSI/BHMA A156.3	(2014) Exit Devices
ANSI/BHMA A156.4	(2013) Door Controls - Closers
ANSI/BHMA A156.6	(2010) Architectural Door Trim
ANSI/BHMA A156.7	(2014) 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	(2015; ERTA 2015) 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
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UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(2012) Building Materials Directory
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## 1.2 SUBMITTALS

Submit the following in accordance with contract requirements.

SD-02 Shop Drawings

Hardware schedule

Keying system

SD-03 Product Data

Hardware items

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule

SD-11 Closeout Submittals

Key Bitting

## 1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

## 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.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge,

or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

#### 1.5.2 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 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### 2.2 TEMPLATE HARDWARE

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.

#### 2.3 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." 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.

#### 2.4 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.

##### 2.4.1 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.

## 2.4.2 Locks and Latches

### 2.4.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.

### 2.4.2.2 Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 1.

### 2.4.3 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with seven pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer.

#### 2.4.3.1 Pushbutton Lock

Provide extra heavy duty mechanical pushbutton access without control wiring, electronics or batteries. Provide key override, vandal resistant keypad, solid cast housings and lever, durability ANSI A156.13, warranty of one year, finish to be selected from manufacturer's standard finishes.

#### 2.4.4 Keying System

Provide an extension of the existing keying system.

#### 2.4.5 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

##### 2.4.5.1 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.

##### 2.4.5.2 Texture

Provide knurled or abrasive coated knobs or lever handles where specified in paragraph entitled "Hardware Schedule".

#### 2.4.6 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. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

#### 2.4.7 Door Bolts

ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts:  
ANSI/BHMA A156.3, Type 25.

#### 2.4.8 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, 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.

##### 2.4.8.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

#### 2.4.9 Overhead Holders

ANSI/BHMA A156.8.

#### 2.4.10 Closer Holder-Release Devices

BHMA A156.15.

#### 2.4.11 Door Protection Plates

ANSI/BHMA A156.6.

#### 2.4.12 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

#### 2.4.13 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

#### 2.4.14 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule".

#### 2.4.15 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

### 2.5 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.

## 2.6 FINISHES

Provides finishes as schedlued.

## 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 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 .

### 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 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.

### 3.5 HARDWARE SETS

#### 3.5.1 HW GROUP - 001

1.0 EA	PUSHBUTTON LOCK	E5010R-WL-26D	SIM
1.0 EA	WRAP AROUND	81-2-S	DON
1.0 EA	DOOR CLOSER	351 O EN	SAR
1.0 EA	DOOR SEAL	S88D17	PEM

#### 3.5.2 HW GROUP - 002

3.0 EA	HINGE	TA2314 4.5 X 4.5 US26D-NRP	MCK
1.0 EA	PUSHBUTTON LOCK	E5010R-WL-26D	SIM
1.0 EA	DOOR CLOSER	351 O EN	SAR
1.0 EA	DOOR SEAL	S88D25	PEM

#### 3.5.3 HW GROUP - 003

3.0 EA	HINGE	TA2314 4.5 X 4.5 US26D-NRP	MCK
1.0 EA	OFFICE LOCK	28-10G05 LL US26D WBX	SAR
1.0 EA	BORED DEADLOCK	485 US26D	SAR
2.0 EA	DOOR CLOSER	351 O EN	SAR
1.0 EA	DOOR SEAL	S88D25	PEM

#### 3.5.4 HW GROUP 004

6.0 EA	HINGE	TA2314 4.5 X 4.5 US26D-NRP	MCK
1.0 EA	SURFACE VR EXIT DEV	8713 ETL US32D RHR	SAR
1.0 EA	SURFACE VR EXIT DEV	14-8710 US32D	SAR
2.0 EA	DOOR CLOSER	351 P9 EN	SAR
1.0 EA	THRESHOLD	171A 72"	PEM
1.0 EA	DOOR SEAL	S88D25	PEM
2.0 EA	DOOR SEAL	29310CS 84"	PEM

#### 3.5.5 HW GROUP 005

1.0 EA	THRESHOLD	171A 48"	PEM
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-- 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

ASTM INTERNATIONAL (ASTM)

ASTM C1036 (2010; E 2012) Standard Specification for Flat Glass

ASTM C1172 (2014) 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 E1300 (2012a; E 2012) Determining Load Resistance of Glass in Buildings

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual (2004) Glazing Manual

GANA Sealant Manual (2008) Sealant 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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

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. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201 Safety Standard for Architectural Glazing  
Materials

1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-03 Product Data

Laminated Safety Glass

Fire Rated Glass

Glazing Accessories

Manufacturer's descriptive product data, handling and storage  
recommendations, installation instructions, and cleaning  
instructions.

SD-04 Samples

Laminated Safety 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.

1.3 SYSTEM DESCRIPTION

Fabricate and install watertight and airtight glazing systems to withstand  
thermal movement and wind loading without glass breakage, gasket failure,  
deterioration of glazing accessories, or defects in the work. Glazed  
panels must comply with the safety standards, in accordance with ANSI Z97.1,

and 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 above 40 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.

### PART 2 PRODUCTS

#### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### 2.2 GLASS

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

##### 2.2.1 Clear Glass

Type I, Class 1 (clear), Quality q4 (A). 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.

##### 2.2.2 GL-1: Laminated Safety Glass

ASTM C1172, Kind LA fabricated from two nominal 1/8 inch pieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C1036. Flat glass must be laminated together with a minimum of 0.035 inch thick, clear polyvinyl butyral interlayer with a total nominal thickness of 1/4 inch.

a. Yellowness-index (ZID) <2.5.

b. U Value > 0.45/

c. SHGC > 0.08

##### 2.2.3 Gl-2: Fire Rated Glass

Fire-rated non-impact safety-rated ceramic glazing

#### 2.2.3.1 Properties

- a. Thickness: 3/16 inch.
- b. STC rating: 35 dB.
- c. Approximate Visible Transmission: 88 percent.
- d. Fire-rating: 20 minutes to 90 minutes.
- e. Positive Pressure Test: UL 10C, UBC 7-2 and 7-4; passes.
- f. Hardness (Vicker's Scale): 700.

#### 2.2.3.2 Labeling

Glass for fire-rated windows must bear an identifying UL label or the label of a nationally recognized testing agency, and be rated for 45 minutes when tested in accordance with NFPA 257.

### 2.3 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 must be gray or neutral color.

#### 2.3.1 Putty and Glazing Compound

Provide glazing compound as recommended by manufacturer for face-glazing metal sash. Putty must be linseed oil type. Do not use putty and glazing compounds with insulating glass or laminated glass.

#### 2.3.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

#### 2.3.3 Sealants

Provide elastomeric sealants.

##### 2.3.3.1 Elastomeric Sealant

ASTM C920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant must be chemically compatible with setting blocks, edge blocks, and sealing tapes. Color of sealant must be white.

##### 2.3.3.2 Structural Sealant

ASTM C1184, Type S.

#### 2.3.4 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.

### 2.3.5 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 must be chemically compatible with the product being set.

### 2.3.6 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks must be dense extruded type conforming to ASTM C509 and ASTM D395, Method B, Shore A durometer between 70 and 90. Edge blocking must be Shore A durometer of 50 (plus or minus 5). Provide silicone setting blocks when blocks are in contact with silicone sealant. Profiles, lengths and locations must be as required and recommended in writing by glass manufacturer. Block color must be black.

### 2.3.7 Glazing Gaskets

Glazing gaskets must 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 must be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets must be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Provide glazing gasket profiles as recommended by the manufacturer for the intended application.

#### 2.3.7.1 Fixed Glazing Gaskets

Fixed glazing gaskets must be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C509, Type 2, Option 1.

#### 2.3.7.2 Wedge Glazing Gaskets

Wedge glazing gaskets must 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.

#### 2.3.7.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing must be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

### 2.3.8 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

## PART 3 EXECUTION

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

### 3.1 PREPARATION

Preparation, unless otherwise specified or approved, must 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, must 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 Installation of Wire Glass

Install glass for fire doors in accordance with installation requirements of NFPA 80.

#### 3.2.3 Installation of Laminated Glass

Sashes which are to receive laminated glass must be weeped to the outside to allow water drainage into the channel.

### 3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass must be clean at the time the work is accepted.

### 3.4 PROTECTION

Protect glass work immediately after installation. Identify glazed openings with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Protect reflective glass with a protective material to eliminate any contamination of the reflective coating. Place

protective material far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Remove and replace glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities with new units.

-- End of Section --

SECTION 08 91 00

METAL WALL LOUVERS  
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 B32 (2008; R 2014) Standard Specification for Solder Metal

ASTM B370 (2012) Standard Specification for Copper Sheet and Strip for Building Construction

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4050 Copper in Architecture - Design Handbook

1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-02 Shop Drawings

Wall louvers

SD-03 Product Data

Wall Louvers

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

## 2.2 MATERIALS

### 2.2.1 Copper

Cold-rolled copper sheets conforming to ASTM B370 temper designation, H00, minimum containing 99.9 percent copper.

- a. Frame: 20 gage, minimum.
- b. Louvers: 20 gage, minimum.
- c. Sill Pan Flashing: 16 gage, minimum.

### 2.2.2 Solder and Flux

Copper solder shall conform to ASTM B32. Flux shall be rosin, muriatic acid neutralized with zinc or an approved soldering paste.

### 2.2.3 Screens

Provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening.

### 2.2.4 Sealant

Provide sealant in accordance with CDA A4050 and manufacturer's recommendations. Submit descriptive information.

### 2.2.5 Fasteners and Accessories

Provide copper, brass or Series 300 stainless steel screws and fasteners. Exposed fasteners shall be copper. Provide other accessories as required for complete and proper installation.

### 2.2.6 Bituminous Coating

Bituminous coating shall be cold-applied inert-type noncorrosive compound, nominally free of sulfur components and other deleterious impurities.

## 2.3 FABRICATION

Louvers, frame and sill pan shall be factory-fabricated in accordance with approved drawings and CDA A4050 recommendations. Form sections true to shape, accurate in size and free of distortion and defects. Exposed edges shall be hemmed on underside. Fabricate exposed copper work without excessive oil-canning, buckling, and tool marks.

### 2.3.1 Screens

Mount screens in removable, rewirable frames of same material and finish as the louvers.

## 2.4 Finish

Remove grease and oil films, excess sealants and handling marks and clean louvers to provide for uniform oxidation.



PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.3 Cleaning

Remove grease and oil films, excess sealants and handling marks and clean the work in accordance with manufacturer's recommendations. Copper surfaces shall be cleaned of substances that would interfere with uniform oxidation and weathering. Exposed copper surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks.

-- End of Section --

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD

02/10

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341 (2010) Seismic Provisions for Structural Steel Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M (2010) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

ASTM A653/A653M (2013) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM C645 (2014) Nonstructural Steel Framing Members

ASTM C754 (2015) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

ASTM C841 (2003; R 2013) Installation of Interior Lathing and Furring

ASTM C847 (2014a) Standard Specification for Metal Lath

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM EMLA 920 (2009) Guide Specifications for Metal Lathing and Furring

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance (2014) Fire Resistance Directory

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

2.2 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, G-60; aluminum coating ASTM A463/A463M, T1-25; or a 55-percent aluminum-zinc coating. Provide support systems and attachments per AISC 341 in seismic zones.

2.2.1 Materials for Attachment of Lath

2.2.1.1 Suspended and Furred Ceiling Systems and Wall Furring

ASTM C841, and ASTM C847.

2.2.1.2 Non-loadbearing Wall Framing

NAAMM EMLA 920.

2.2.2 Materials for Attachment of Gypsum Wallboard

2.2.2.1 Suspended and Furred Ceiling Systems

ASTM C645.

2.2.2.2 Nonload-Bearing Wall Framing and Furring

ASTM C645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures .

2.2.2.3 Furring Structural Steel Columns

ASTM C645. Steel (furring) clips and support angles listed in UL Fire Resistance may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Gypsum Wallboard

3.1.1.1 Suspended and Furred Ceiling Systems

ASTM C754, except provide framing members 16 inches o.c. unless indicated otherwise.

3.1.1.2 Non-loadbearing Wall Framing and Furring

ASTM C754, except as indicated otherwise.

### 3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/4 inch in 8 feet from a straight line;
- c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/8 inch in 8 feet from a straight line;
- c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION 09 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.

ASTM INTERNATIONAL (ASTM)

ASTM C1002	(2014) 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 C1396/C1396M	(2014a) Standard Specification for Gypsum Board
ASTM C475/C475M	(2012; E 2014) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C514	(2004; R 2014) 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

GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board Finish
GA 216	(2010) Application and Finishing of Gypsum Panel Products
GA 600	(2009) Fire Resistance Design Manual

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance (2014) Fire Resistance Directory

1.2 DELIVERY, STORAGE, AND HANDLING

1.2.1 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.

1.2.2 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. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.2.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.3 ENVIRONMENTAL CONDITIONS

1.3.1 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.4 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

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.

2.1.1 Gypsum Board

ASTM C1396/C1396M.

2.1.1.1 Regular

48 inch wide, 1/2 and 5/8 inch thick, tapered edges.

2.1.2 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements

identified in Section 01 81 13 Sustainable Design Requirements.

### 2.1.3 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.

#### 2.1.3.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

#### 2.1.3.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

#### 2.1.3.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

#### 2.1.3.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

#### 2.1.3.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

### 2.1.4 Fasteners

#### 2.1.4.1 Nails

ASTM C514.

#### 2.1.4.2 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.

#### 2.1.4.3 Staples

No. 16 USS gage flattened galvanized wire staples with 7/16 inch wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

<u>Length of Legs</u>	<u>Thickness of Gypsum Board</u>
1-1/8 inches	1/2 inch

<u>Length of Legs</u>	<u>Thickness of Gypsum Board</u>
1-1/4 inches	5/8 inch

#### 2.1.5 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene. Adhesive shall contain a maximum VOC content of 50 grams per liter.

##### 2.1.5.1 Adhesive for Fastening Gypsum Board to Metal Framing

Type recommended by gypsum board manufacturer.

##### 2.1.5.2 Adhesive for Fastening Gypsum Board to Wood Framing

ASTM C557.

#### 2.1.6 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.

#### 2.1.7 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.

#### 3.2 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. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. 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 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

### 3.2.4 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.

## 3.3 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.

### 3.3.1 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 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 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.

### 3.6 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

-- 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	(2015) 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 A489	(2012) Standard Specification for Carbon Steel Lifting Eyes
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
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 E1264	(2014) Acoustical Ceiling Products
ASTM E1414/E1414M	(2011a; E 2014) 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	(2015a) Standard Test Method for Surface Burning Characteristics of Building Materials

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2013) Seismic Design for Buildings
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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 Ceiling Attenuation Class and Test

Provide a ceiling system with an attenuation class (CAC) of 25 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.

1.2.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423 Test Method.

1.2.3 Light Reflectance

Determine light reflectance factor in accordance with ASTM E1477 Test Method.

1.2.4 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.

### 1.3 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-03 Product Data

Acoustical Units

SD-04 Samples

Acoustical Units

### 1.4 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.

### 1.5 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

### 1.6 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

### 1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

### 2.2 ACOUSTICAL UNITS

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:

#### 2.2.1 Units for Exposed-Grid System

##### 2.2.1.1 Type

Type XX - Stone wool base with membrane-faced overlay.

##### 2.2.1.2 Fire Performance

Class A, Flame Spread Index 0, Smoke developed Index 5, ASTM E84.

##### 2.2.1.3 Pattern

G

##### 2.2.1.4 Minimum NRC

0.75, ASTM E795.

##### 2.2.1.5 Minimum Light Reflectance Coefficient LR-1, 0.85 or greater

##### 2.2.1.6 Nominal Size

24 by 24 inch

##### 2.2.1.7 Edge Detail

Square Tegular

##### 2.2.1.8 Finish

Factory-applied standard finish .

##### 2.2.1.9 Minimum CAC

25

#### 2.3 SUSPENSION SYSTEM

Provide standard exposed-grid narrow width flange suspension system conforming to ASTM C635/C635M for intermediate-duty systems . Provide surfaces exposed to view of aluminum or steel with a factory-applied white baked-enamel finish . Provide wall molding having a flange of not less than 9/16. Provide standard overlapped 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 .

#### 2.4 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

#### 2.4.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.08 inch (12 gauge) in diameter.

#### 2.4.2 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.

#### 2.4.3 Rods

Provide 3/16 inch diameter threaded steel rods, zinc or cadmium coated.

#### 2.4.4 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.

### 2.5 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.

## 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. 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.

#### 3.2 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.

-- 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 F386	(2011) Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces
ASTM E648	(2014c) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
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 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 F1914	(2011) Standard Test Methods for Short-Term Indentation and Residual Indentation of Resilient Floor CoveringRef Title
ASTM F2055	(2010) Standard Test Method for Size and Squareness of Resilient Floor Tile by Dial Gage Method
ASTM F2170	(2011) Determining Relative Humidity in Concrete Floor Slabs in situ Probes
ASTM F710	(2011) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 253	(2011) Standard Method of Test for Critical Radiant Flux of Floor Covering
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Systems Using a Radiant Heat Energy Source

1.2 SYSTEM DESCRIPTION

1.2.1 Fire Resistance Requirements

Provide a critical radiant flux of not less than 0.45 watts per square centimeter (Class 1) for flooring in corridors and exits when tested in accordance with ASTM E648 or NFPA 253.

1.3 SUBMITTALS

Submit the following in accordance with contract documents:

SD-03 Product Data

Vinyl Tile  
Wall Base  
Resilient Flooring and Accessories  
Adhesives  
Surface Preparation Materials

SD-04 Samples

Resilient Flooring and Accessories; G

SD-08 Manufacturer's Instructions

Surface Preparation  
Installation

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

1.4 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 with ambient air temperature maintained below 85 degrees F, stacked according to manufacturer's recommendations. 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.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

#### 1.6 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

#### 1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

#### 1.8 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles 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 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### 2.2 SOLID STATIC DISSIPATIVE VINYL TILE

Conform to ASTM F1700 Class I, Type A, Federal Specifications SS-T-312B, Type III>

- a. Size tolerance:  $\pm 0.016$  in./lin Ft (0.4mm/305mm) ASTM F2055
- b. Thickness: As specified  $\pm 0.005$  in (0.13mm) ASTM F386
- c. Residual Indentation: Average less than 8%, maximum single reading 10% ASTM F1914
- d. Certified under the Greenguard or FloorScore indoor emissions testing programs

#### 2.3 WALL BASE

Conform to ASTM F1861, Type TS (vulcanized thermoset rubber), Style A (straight - installed with carpet), and Style B (coved - installed with resilient flooring) . Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide job formed corners in matching height, shape, and color.

#### 2.4 MOULDING

Provide tapered mouldings of rubber 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.

## 2.5 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

## 2.6 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.

## 2.7 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D4078 for polish.

## 2.8 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

## 2.9 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as indicated on the drawings. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern.

# PART 3 EXECUTION

## 3.1 EXAMINATION

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 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.

### 3.6 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.

### 3.7 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.

### 3.8 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 134 (2011; E 2013) Electrostatic Propensity of Carpets

ASTM INTERNATIONAL (ASTM)

ASTM D3278 (1996; R 2011) Flash Point of Liquids by Small Scale Closed-Cup Apparatus

ASTM D5793 (2013) Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings

ASTM D6859 (2011) Standard Test Method for Pile Thickness of Finished Level Pile Yarn Floor Coverings

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. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1630 Standard for the Surface Flammability of Carpets and Rugs (FF 1-70)

1.2 SUBMITTALS

Submit the following in accordance with contract documents:

SD-03 Product Data

Carpet

Moldings

SD-04 Samples

Carpet  
Moldings

SD-08 Manufacturer's Instructions

Surface Preparation  
Installation

SD-10 Operation and Maintenance Data

Carpet  
Cleaning and Protection

1.3 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. 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 .

1.4 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 protected from damage, soiling, and moisture, and maintain at a temperature above 60 degrees F for 2 days prior to installation. Do not store carpet near materials that may off gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 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.

1.6 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 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

2.2 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

2.2.1 Physical Characteristics for Modular Tile Carpet

2.2.1.1 Carpet Construction

Tufted

2.2.1.2 Type

Modular tile 20 by 20 inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

2.2.1.3 Pile Type

Textured Loop

2.2.1.4 Pile Fiber

Commercial 100 percent branded (federally registered trademark) nylon continuous filament .

2.2.1.5 Gauge or Pitch

Minimum 1/12 inch in accordance with ASTM D5793

2.2.1.6 Stitches or Rows/Wires

Minimum 9.7 per square inch

2.2.1.7 Total Thickness

Minimum 0.205 inch in accordance with ASTM D6859

2.2.1.8 Pile Density

Minimum 6,000 ounces per square yard

2.2.1.9 Dye Method

Solution dyed

2.2.1.10 Backing Materials

Provide primary backing materials like synthetic material . Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

2.3 PERFORMANCE REQUIREMENTS

2.3.1 Static Control

Provide static control to permanently regulate static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.

2.3.2 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 0.45 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 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 .

2.6 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with 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 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 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

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. 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.

#### 3.4.1 Modular Tile Installation

Install modular tiles with releasable adhesive and snug joints. Use brick installation method. Provide accessibility to the subfloor where required.

### 3.5 CLEANING AND PROTECTION

Submit 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

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.

#### 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 MAINTENANCE

3.6.1 Extra Materials

Provide extra material from same dye lot for future maintenance. Provide a minimum of 3 percent of total square yards of each carpet type, pattern, and color.

-- 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 D235 (2002; R 2012) Mineral Spirits (Petroleum  
Spirits) (Hydrocarbon Dry Cleaning Solvent)

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 F1869 (2011) Measuring Moisture Vapor Emission  
Rate of Concrete Subfloor Using Anhydrous  
Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 107 (Oct 2009) Rust Inhibitive Primer  
(Water-Based)

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 39 (Oct 2009) Interior Latex-Based Wood Primer

MPI 50 (Oct 2009) Interior Latex Primer Sealer

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 SP 1 (2015) 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. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313 (2014; Rev E) Material Safety Data,  
Transportation Data and Disposal Data for  
Hazardous Materials Furnished to  
Government Activities

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

29 CFR 1910.1000 Air Contaminants  
29 CFR 1910.1025 Lead  
29 CFR 1926.62 Lead

1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-03 Product Data

Coating

Manufacturer's Technical Data Sheets

SD-04 Samples

Color

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

### Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

### SD-10 Operation and Maintenance Data

#### Coatings

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

## 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 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

## 1.4 REGULATORY REQUIREMENTS

### 1.4.1 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.

#### 1.4.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

#### 1.4.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

#### 1.4.4 Asbestos Content

Materials shall not contain asbestos.

#### 1.4.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

#### 1.4.6 Silica

Abrasive blast media shall not contain free crystalline silica.

#### 1.4.7 Human Carcinogens

Materials shall not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

### 1.5 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.

### 1.6 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. 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.

#### 1.6.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

#### 1.6.2 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. Additional guidance is given in SSPC Guide 6 and SSPC Guide 7.

#### 1.7 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.

##### 1.7.1 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 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be as indicated .

#### 1.9 LOCATION AND SURFACE TYPE TO BE PAINTED

##### 1.9.1 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.

#### 1.9.1.1 Exterior Painting

Includes new surfaces and existing coated surfaces of the building and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

#### 1.9.1.2 Interior Painting

Includes new surfaces and existing coated surfaces of the building 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.

#### 1.9.2 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.

#### 1.9.3 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.

#### 1.9.4 Definitions and Abbreviations

##### 1.9.4.1 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.

##### 1.9.4.2 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

##### 1.9.4.3 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.

##### 1.9.4.4 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

##### 1.9.4.5 EXT

MPI short term designation for an exterior coating system.

##### 1.9.4.6 INT

MPI short term designation for an interior coating system.

##### 1.9.4.7 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

##### 1.9.4.8 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.

##### 1.9.4.9 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

##### 1.9.4.10 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).

#### 1.9.4.11 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.

#### 1.9.4.12 Paint

See Coating definition.

#### 1.9.4.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

#### 1.9.4.14 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. Comply with applicable regulations regarding toxic and hazardous materials.

#### 2.1.1 VOC LIMITS

Interior Paints and Coatings: For interior field-applied applications, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24) and the chemical restrictions (Restricted Components listed below) of Green Seal Standard GS-11, Paints, First Edition, May 20, 1993; Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997; and South Coast Air Quality Management District Rule 1113, Architectural Coatings, rules in effect on January 1, 2004, as follows:

- a. Flat Paints and Coatings: Not more than 10 grams of VOC per liter of

coating less water and exempt compounds, including pigments.

- b. Non-Flat Paints and Coatings except High Gloss: Not more than 50 grams of VOC per liter of coating less water and exempt compounds, including pigments.
- c. High Gloss Paints and Coatings: Not more than 150 grams of VOC per liter of coating less water and exempt compounds, including pigments. High Gloss Coatings are coatings that register a gloss of 70 or above on a 60-degree meter according to ASTM Test Method D 523 as specified in paragraph (e)(6).
- d. Water-Based Polychromatic Finish Coatings: Not more than 150 g/L (150 g/L for primer and flat polychromatic paint).
- e. Anti-Corrosive Coatings: Not more than 100 grams of VOC per liter of coating less water and exempt compounds.
- f. Sanding Sealers: Not more than 50 grams of VOC per liter of coating less water and exempt compounds.
- g. Waterproofing Sealers: Not more than 100 grams of VOC per liter of coating less water and exempt compounds.
- H. Polyurethanes: Not more than 100 grams of VOC per liter of coating less water and exempt compounds.

#### 2.1.2 Antimicrobial Additives

Interior paints shall not contain antimicrobial additives (such as fungicides and biocides).

#### 2.1.3 Aromatic Compounds

Paints and coatings shall not contain more than 1% (by weight) total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

#### 2.1.4 Restricted Components

Paints and coatings shall not contain any of the following:

- a. Acrolein
- b. Acrylonitrile
- c. Analine dyes
- d. Antimony
- e. Benzene
- f. Butyl benzyl phthalate
- g. Cadmium
- h. Di (2-ethylhexyl) phthalate
- i. Di-n-butyl phthalate

- j. Di-n-octyl phthalate
- k. 1, 2-dichlorobenzene
- l. Diethyl phthalate
- m. Dimethyl phthalate
- n. Ethylbenzene
- o. Formaldehyde
- p. Hexavalent chromium
- q. Isophorone
- r. Lead
- s. Mercury
- t. Methyl ethyl ketone
- u. Methyl isobutyl ketone
- v. Methylene chloride
- w. Naphthalene
- x. Toluene (methylbenzene)
- y. 1, 1, 1-trichloroethane
- z. Vinyl chloride
- aa. Xylene

### PART 3 EXECUTION

#### 3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

#### 3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, 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.

### 3.2.1 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 or 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.

### 3.2.2 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 so that when tested in accordance with ASTM D4214, the chalk rating is not less than 8.

### 3.2.3 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.

#### 3.2.4 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.

### 3.3 PREPARATION OF METAL SURFACES

#### 3.3.1 Existing and New Ferrous Surfaces

- a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, , or SSPC SP 10/NACE No. 2. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.
- b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/NACE No.3 /SSPC SP 12/NACE No.5 WJ-3.

#### 3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

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.

#### 3.3.3 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.

#### 3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

### 3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

#### 3.4.1 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 surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.
  - (2) Fungus and Mold: Wash new, existing coated, surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
  - (3) Paint and Loose Particles: Remove by wire brushing.
  - (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.
- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.
- d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

### 3.4.2 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.

### 3.4.3 Existing Asbestos Cement Surfaces

Remove oily stains by solvent cleaning with mineral spirits, 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.

## 3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

### 3.5.1 New 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.

### 3.6 APPLICATION

#### 3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's

recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

- c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

### 3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

### 3.6.3 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.

### 3.6.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

#### 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.

### 3.7 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.

### 3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

### 3.9 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.

### 3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with ASME A13.1. Place stenciling in clearly visible locations. On piping not covered by 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.

### 3.11 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.

### 3.12 WASTE MANAGEMENT

Coordinate with paint manufacturers for implementing a "take-back program" for all unused paint. Set aside scrap and unused paint to be returned to the manufacturer for recycling into new product. Close and seal all partially used containers of paint to maintain quality as necessary for reuse.

### 3.13 PAINT TABLES

All DFT's are minimum values.

#### 3.13.1 INTERIOR PAINT TABLES

##### DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

#### A. Existing, previously painted Concrete masonry:

##### 1. 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)

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	

##### DIVISION 6: INTERIOR WOOD PAINT TABLE

#### A. New Wood and plywood not otherwise specified:

##### 1. 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	

DIVISION 6: INTERIOR WOOD PAINT TABLE

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:  
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. 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

Existing; MPI RIN 6.4D-G5 (Semigloss)  
Primer: Intermediate: Topcoat:  
MPI 39 MPI 147 MPI 147  
System DFT: 4 mils

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New and Existing, previously painted Plaster and Wallboard not otherwise specified:

1. 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)



DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

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	

-- End of Section --

SECTION 10 14 00.20

INTERIOR SIGNAGE  
11/12

PART 1 GENERAL

1.1 REFERENCES

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

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 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Installation

1.3 QUALITY ASSURANCE

1.3.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: Directional sign, Standard Room sign, The samples may be installed in the work, provided each sample is identified and location recorded.

1.3.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule showing the location, each sign type, and message.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

#### 1.5 WARRANTY

Warrant the interior signage for a period of 2 years against defective workmanship and material. Warranties shall be signed by the authorized representative of the manufacturer. Submit warranty accompanied by the document authenticating the signer as an authorized representative of the guarantor. Guarantee that the signage products and the installation are free from any defects in material and workmanship from the date of delivery.

### PART 2 PRODUCTS

#### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### 2.2 STANDARD PRODUCTS

Signs, plaques, directories, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products that essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening. Obtain signage from a single manufacturer with edges and corners of finished letterforms and graphics true and clean.

#### 2.3 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

##### 2.3.1 Standard Room Signs

Signs shall consist of acrylic plastic 0.080 inch thickness minimum conforming to ANSI Z97.1 and shall conform to the following:

Units shall be frameless. Corners of signs shall be as indicated.

##### 2.3.2 Type of Mounting For Signs

Surface mounted signs shall be mounted with 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. fabricated from materials that are not corrosive to sign material and mounting surface.

##### 2.3.3 Graphics

Signage graphics for modular signs shall conform to the following:

##### 2.3.3.1 Surface Applied Photopolymer

Integral graphics and Braille achieved by photomechanical stratification processes. Photopolymer used for ADA compliant graphics shall be of the type that has a minimum durometer reading of 90. Tactile graphics shall be raised 1/32 inch from the first surface of plaque by photomechanical stratification process.

#### 2.3.4 Character Proportions and Heights

Letters and numbers on signs conform to 36 CFR 1191.

#### 2.3.5 Tactile Letters, Symbols and Braille

Raised letters and numbers on signs shall conform to 36 CFR 1191.

#### 2.4 COLOR, FINISH, AND CONTRAST

Color shall be as indicated . Finish of all signs shall be eggshell, matte, or other non-glare finish as required in handicapped-accessible buildings.

#### 2.5 TYPEFACE

ADA-ABA compliant font for Room Signs.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Signs shall be installed plumb and true and in accordance with manufacturer's instructions at locations shown on the detail drawings.

##### 3.1.1 Protection and Cleaning

Protect the work against damage during construction. Frames, and other sign surfaces shall be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions .

-- End of Section --

SECTION 10 44 16

FIRE EXTINGUISHERS  
05/15

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-03 Product Data

Fire Extinguishers

1.2 DELIVERY, STORAGE, AND HANDLING

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

PART 2 PRODUCTS

Submit fabrication drawings consisting of fabrication and assembly details performed in the factory and product data for the following items:  
Accessories and Wall Brackets.

2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

2.2 FIRE EXTINGUISHERS

2.2.1 Material

Provide extinguisher shell.

2.2.2 Size

5 pounds extinguishers.

2.2.3 Accessories

Forged brass valve

Safety release

Pressure gage

2.3 EQUIPMENT

2.3.1 Wall Brackets

Provide spring-clip fire extinguisher wall brackets.

Provide wall bracket and accessories as approved.

PART 3 EXECUTION

3.1 INSTALLATION

Comply with the manufacturer's recommendations for all installations.

3.2 PROTECTION

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 12 24 13

ROLLER WINDOW SHADES  
08/10

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

Provide roller window shades, complete with necessary brackets, fittings, and hardware as indicated. Mount and operate equipment in accordance with manufacturer's instructions. Windows to receive a shade shall be completely covered.

- a. Submit drawings showing plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work. Include the use of same room designations as indicated on the drawings.
- b. Provide manufacturer's data composed of catalog cuts, brochures, product information, and operating and maintenance instructions on each product to be used. Include styles, profiles and features.
- c. Furnish samples of each type and color of roller shade fabric and roller shade channel. Shade material shall be minimum 6 by 6 inch in size. Mark face of material to indicate interior faces.
- d. Mock up: Install shade in area designated by Contracting Officer. Do not proceed with remaining work until the Contracting Officer approves workmanship and operation. Re-work mock-up as required to produce acceptable work. The approved shade can be used in installation.
- e. Submit fire resistance data, flame spread and smoke contribution data.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM G21 (2013) Determining Resistance of Synthetic  
Polymeric Materials to Fungi

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 (2015) Standard Methods of Fire Tests for  
Flame Propagation of Textiles and Films

1.3 SUBMITTALS

Submit the following in accordance with contract requirements

SD-03 Product Data

Window Shades

Shade Material

SD-04 Samples

Shade Material

SD-10 Operation and Maintenance Data

Window Shades

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.2 Flammability Requirements

Passes in accordance with NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

1.4.3 Anti-Microbial Requirements

'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area. Do not open containers until needed for installation unless verification inspection is required.

1.6 WARRANTY

Provide 10 year minimum limited warranty.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

2.2 WINDOW SHADES

Roller tube shall operate smoothly and be of sufficient diameter and thickness to prevent excessive deflection. Provide brackets that are appropriate for mounting indicated. The shade cloth shall meet the performance described in NFPA 701, small scale test. Treat steel features for corrosion resistance.

2.2.1 Light Filtering Shades

Provide light filtering window shades to conform with the following:

- a. Roller tube shall be extruded aluminum or steel. Diameter, wall thickness, and material to be selected by the manufacturer to



accommodate the shade size. Provide roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin shall allow easy installation and removal of roller. Fabric shall be connected to the roller tube with double sided adhesive specifically developed to attach coated textiles to metal to eliminate horizontal impressions in fabric or attached with a spline lock system.

- b. Fascia shall be L-shaped aluminum extrusion to conceal shade roller and hardware that snaps onto end caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands.
- c. End caps shall be stamped steel with universal design suitable for mounting to window mullions. Provide size compatible with roller size. End cap covers shall match fascia/headbox finish.
- d. Provide hardware that allows for field adjustment or removal of shade roller tube and other operable hardware component without requiring removal of brackets and end or center supports.
- e. Manual Operated Chain Drive Hardware shall provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change. Provide positive mechanical engagement of drive mechanism to shade roller tube. The drive bracket shall be fully integrated with all accessories. Drive chain shall be #10 stainless steel chain rated to 90 lb. minimum breaking strength.

### 2.3 SHADE MATERIAL

Provide color, pattern and texture for metal and shade fabric as indicated . Color listed is not intended to limit the selection of equal colors from other manufacturers.

## PART 3 EXECUTION

### 3.1 FIELD MEASUREMENTS

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work. Provide fabric with the following properties

- a. Composition: 21% Polyester, 79% Vinyl on Polyester
- b. Mesh Weight: 16.4 ounces/square yard.
- c. b. Fabric Thickness: 0.037 inches.
- d. Openness Factor: Approximately 5 percent.
- e. Uv Blockage: Approximately 95%
- f. Breaking Strength : 190 pounds Warp, 285 pounds Fill

### 3.2 INSTALLATION

Perform installation in accordance with the approved detail drawings and manufacturer's installation instructions. Install units level, plumb,

secure, and at proper height and location relative to window units. Provide and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

### 3.3 CLEAN-UP

Upon completion of the installation, clean window treatments and adjust them for form and appearance and proper operating condition. Repair or replace damaged units as directed by the Contracting Officer. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure shades installed in recessed pockets can be removed without disturbing the pocket. The entire shade, when retracted, shall be contained inside the pocket. For shades installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --

SECTION 12 48 13

ENTRANCE FLOOR MATS AND FRAMES

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 within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 1028	(2007) Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM D2047	(2011) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM E648	(2014c) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

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
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1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-03 Product Data

Roll-Up Mats

1.3 QUALITY ASSURANCE

Comply with 36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines for installed entrance floor mats and frames. Ensure entrance floor mats are slip resistant in accordance with ASTM D2047, Coefficient of Friction, minimum 0.60 for accessible routes. Ensure flammability is in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/m<sup>2</sup>.

1.4 DELIVERY OF MATERIALS

Deliver materials to the project site in their original packages or containers bearing labels clearly identifying the manufacturer, brand name,

and quality or grade.

Store materials in their original unbroken packages or containers in the area in which they will be installed. Unwrap, inspect, and place mats at indicated location. Remove all excess packing materials.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

### 2.2 Entrance Floor Mats

Submit manufacturer's catalog data.

#### 2.2.1 Roll-Up Mats

Roll-up mats surface mounted and provided with carpet consisting of nylon or polypropylene carpet fibers fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths. Carpet has anti-static and anti-stain treatments inserts.

- a. Weight 18 ozs/sqyd
- b. Thickness: 3/8 inch
- c. Anti-static: Maximum average voltage of 1.6 KV, AATCC 134 Electrostatic Propensity Test
- d. Static Coefficient of Friction: Dry 0.70, ASTM C 1028

### 2.3 COLOR AND SIZE

Ensure color is in accordance with the drawings. Size of mat is as indicated.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Comply with manufacturer's requirements of substrates and floor conditions affecting installation of floor mats and frames. Installation cannot occur until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

Install floor mats according to manufacturer's instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action. Coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.

Provide manufacturer's maintenance information.

-- 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 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

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

ASME INTERNATIONAL (ASME)

ASME A13.1 (2007; R 2013) Scheme for the  
Identification of Piping Systems

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 2015) 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

ASTM E2016 (2011) Standard Specification for Industrial Woven Wire Cloth

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2014) 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 701 (2015) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS Scientific Certification Systems (SCS)Indoor Advantage

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. DEPARTMENT OF ENERGY (DOE)

PL-109-58 (1992; R 2005) Energy Efficient Procurement Requirements

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

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

40 CFR 82 Protection of Stratospheric Ozone

UL ENVIRONMENT (ULE)

ULE Greenguard

UL Greenguard Certification Program

UNDERWRITERS LABORATORIES (UL)

UL 6

(2007; Reprint Nov 2014) Electrical Rigid  
Metal Conduit-Steel

UL Bld Mat Dir

(2012) Building Materials Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Labels shall be in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Air-cooled Condensing Unit Number	ACCU-1
Fan Coil Unit Number	FCU-1

Identify similar services with different temperatures or pressures. Where pressures could exceed 125 pounds per square inch, gage, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

- a. Each point of entry and exit of pipe passing through walls.
- b. Each change in direction, i.e., elbows, tees.
- c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.
- d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 75 feet. All labels shall be visible and legible from the primary service and operating area.

1.2.2 Color Coding

Color coding of all piping systems shall be in accordance with ASME A13.1 .

1.3 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Duct Connectors  
Manual Balancing Dampers  
Louvers  
Test Procedures

SD-06 Test Reports

Performance Tests

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions  
Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals  
Room Fan-Coil Units

Variable Refrigerant Flow Systems

SD-11 Closeout Submittals

Energy Efficient Equipment; S  
Reduce Volatile Organic Compounds (VOC); S  
Indoor Air Quality During Construction; S  
Ozone Depleting Substances for Refrigerants; S

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.



- d. Where products are specified to meet or exceed the specified energy efficiency requirement of FEMP-designated or Energy Star certified product categories, equipment selected shall have as a minimum the efficiency rating identified under "Energy-Efficient Products" at <http://www1.eere.energy.gov/femp/procurement>.

These specifications conform to the efficiency requirements as defined in Public Law PL-109-58, "Energy Policy Act of 2005" for federal procurement of energy-efficient products. Equipment having a lower efficiency than Energy Star or FEMP requirements may be specified if the designer determines the equipment to be more life-cycle cost effective using the life-cycle cost analysis methodology and procedure in 10 CFR 436.

#### 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 A123/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. Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA shall comply with the following:

- a. Do not knowingly vent or otherwise release into the environment, Class I or Class II substances used as a refrigerant.
- b. Do not open appliances without meeting the requirements of 40 CFR 82 Part 82.156 Subpart F, regarding required practices for evacuation and collection of refrigerant, and 40 CFR 82 Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.
- c. Only persons who comply with 40 CFR 82 Part 82.161 Subpart F, regarding technician certification, can conduct work on appliances containing refrigerant.

In addition, provide copies of all applicable certifications to the Contracting Officer at least 14 calendar days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

- a. Proof of Technician Certification

- b. Proof of Equipment Certification for recovery or recycling equipment.
- c. Proof of availability of certified recovery or recycling equipment.

#### 1.4.4 Use of Ozone Depleting Substances, Other than Refrigerants

The use of Class I or Class II ODS's listed as nonessential in 40 CFR 82 Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

- a. Any plastic party spray streamer or noise horn which is propelled by a chlorofluorocarbon
- b. Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays.
- c. Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam used in coaxial cabling.
- d. Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR 82 Part 82.66 Subpart C.

Request a waiver if a facility requirement dictates that a prohibited material is necessary to achieve project goals. Submit the waiver request in writing to the Contracting Officer. The waiver will be evaluated and dispositioned.

#### 1.4.5 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

#### 1.4.6 Test Procedures

Submit proposed test procedures and test schedules for the performance tests of systems, at least 2 weeks prior to the start of related testing.

#### 1.4.7 Sustainable Design Certification

Product shall be third party certified in accordance with ULE Greenguard, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

## 1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

#### 2.1.1 Energy Efficient Equipment

Provide documentation that the following products meet energy efficiency requirements as outlined in this section:

##### Variable Refrigerant Flow Systems

#### 2.1.2 Reduce Volatile Organic Compounds (VOC) for sealants, coatings or adhesives

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### 2.1.3 Ozone Depleting Substances for Refrigerants

Do not use any Ozone Depleting Substances (ODS) as Refrigerants. Base building cooling equipment shall contain no refrigerants other than the following: HCFC-123, HFC-134a, HFC-245fa, HFC-407c, or HFC 410a.

### 2.2 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.

### 2.3 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall

have beveled edges. Install identification plates using a compatible adhesive.

#### 2.4 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard.

#### 2.5 ELECTRICAL WORK

- a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.
- b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1.
- c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.
- d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.
- e. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function. Use solid-state variable-speed controllers for motors rated 10 hp or less and adjustable frequency drives for larger motors.

#### 2.6 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

## 2.7 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.

## 2.8 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

## 2.9 DUCT SYSTEMS

### 2.9.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification .

- a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.
- b. Provide ductwork that meets the requirements of Seal Class A.
- c. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant.
- d. Make spiral lock seam duct, and flat oval with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

#### 2.9.1.1 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 NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

#### 2.9.2 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.

### 2.9.3 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:

- a. 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.
- b. 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.

### 2.9.4 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section 08 91 00 METAL WALL LOUVERS.

### 2.9.5 Bird Screens and Frames

Provide bird screens that conform to ASTM E2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

## 2.10 AIR SYSTEMS EQUIPMENT

### 2.10.1 Air Filters

#### 2.10.1.1 Replaceable Media Filters

Provide the dry-media type replaceable media filters, of the size required to suit the application. See fan-coil unit schedule.

## 2.11 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.

## 2.12 SUPPLEMENTAL COMPONENTS/SERVICES

### 2.12.1 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

### 2.12.2 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate.

### 2.12.3 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 2.12.4 Controls

The requirements for controls are specified on the drawings.

## PART 3 EXECUTION

### 3.1 CONSTRUCTION-RELATED SUSTAINABILITY CRITERIA

Perform and document Indoor Air Quality During Construction. Provide documentation showing that after construction ends, and prior to occupancy, new filters were installed in conformance with Section 01 81 13 SUSTAINABILITY DESIGN REQUIREMENTS.

### 3.2 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.

### 3.3 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.
- 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.

### 3.3.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units . Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.3.2 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.

### 3.3.3 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. 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.

### 3.3.4 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.

### 3.3.5 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.3.6 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

## 3.4 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 28 calendar



days before being loaded.

### 3.5 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.

### 3.6 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.

### 3.7 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.

#### 3.7.1 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.

#### 3.7.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

#### 3.7.3 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.

### 3.7.4 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.

## 3.8 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.

### 3.8.1 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.

### 3.8.2 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

## 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 5 days for each system and demonstrate that the entire system is functioning according to the specifications. Make coincidental chart recordings at points indicated on the drawings for the duration of the time period and record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

Submit test reports for the performance tests in booklet form, upon completion of testing. Document phases of tests performed including initial test summary, repairs/adjustments made, and final test results in

the reports.

### 3.11 CLEANING AND ADJUSTING

Inside of room fan-coil units thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

### 3.12 OPERATION AND MAINTENANCE

#### 3.12.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the contract requirements. 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 4 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

1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-11 Closeout Submittals

Energy Efficient Equipment for Motors; S

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 must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

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 must 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 must 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

For each item of equipment, provide 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, "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.

##### 1.4.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions must be considered mandatory, the word "should" is interpreted as "must." Reference to the "code official" must be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" must be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" must be interpreted to mean the "lessor." References to the "permit holder" must 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, must 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 must 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 must 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 must be included under the section that

specified that motor or equipment. Power wiring and conduit for field installed equipment must be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

#### 1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors must be thoroughly familiar with all parts of the installation and must be trained in operating theory as well as practical operation and maintenance work.

Instruction must 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 must be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

#### 1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

### PART 2 PRODUCTS

#### 2.1 PRODUCT SUSTAINABILITY CRITERIA

##### 2.1.1 Energy Efficient Equipment for Motors

Provide documentation that the motors meet energy efficiency requirements as outlined in this section.

##### 2.1.2 Reduce Volatile Organic Compounds (VOC) for paint/coatings

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

### PART 3 EXECUTION

#### 3.1 PAINTING OF NEW EQUIPMENT

New equipment painting must be factory applied or shop applied, and must 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 must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must 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 must 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 must 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 must 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 must 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 must 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 must 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 must 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.

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

AABC MN-4 (1996) Test and Balance Procedures

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE (2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV (2006) Procedural Standards for Measurements 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.
- c. DALT: Duct air leakage test
- d. DALT'd: Duct air leakage tested
- e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling.
- f. NEBB: National Environmental Balancing Bureau
- g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class." "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by Appendix D REQUIREMENTS FOR DUCT AIR LEAK TESTING." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."
- 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 distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 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 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.
2. Air quantities at air terminals.
3. Air quantities and temperatures in air handling unit schedules.
4. Water quantities and temperatures in thermal energy transfer equipment schedules.
5. Water quantities and heads in pump schedules.
6. Water flow measurement fittings and balancing fittings.
7. Ductwork Construction and Leakage Testing Table that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure. This table is included in the file for Graphics for Unified Facilities Guide Specifications:  
<http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf>

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions, and systems readiness check. The TAB Specialist must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

Submit three copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field measurements.

### 1.3.3 Related Requirements

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

Specific requirements relating to Reliability Centered Maintenance (RCM) principals and Predictive Testing and Inspection (PTI), by the construction contractor to detect latent manufacturing and installation defects must be followed as part of the Contractor's Quality Control program. Refer to the paragraph titled "Sustainability" for detailed requirements.

### 1.4 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-01 Preconstruction Submittals

Records of Existing Conditions

TAB Firm

Designation of TAB team assistants

Designation of TAB team engineer or TAB Specialist

Designation of TAB team field leader

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms

SD-03 Product Data

Equipment and Performance Data

TAB Related HVAC Submittals

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer and assistant.

TAB Procedures

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration

Systems Readiness Check

TAB Execution

TAB Verification

SD-06 Test Reports

TAB Work Execution Schedule

TAB Procedures Summary

Design review report

TAB report

SD-07 Certificates

Independent TAB agency and personnel qualifications

Advance Notice of TAB Field Work

Completed Pre-TAB Work Checklist

TAB Firm

Independent TAB Agency and Personnel Qualifications

TAB Submittal and Work Schedule

Design review report

Pre-field TAB engineering report

Prerequisite HVAC Work Check Out List

## 1.5 QUALITY ASSURANCE

### 1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

### 1.5.2 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

### 1.5.3 Sustainability

Contractor must submit the following as part of the Quality Control Plan for acceptance testing:

- a. List all test equipment to be used, including its manufacturer, model number, calibration date, and serial number.
- b. Certificates of test personnel qualifications and certifications. Provide certification of compliance with 40 CFR 82.
- c. Proof of equivalency if the contractor desires to substitute a test requirement.

Perform the following PTI as an integral part of the TAB process per the most recent edition of the NASA RCBEA GUIDE:

### 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 building systems commissioning and the measuring of sound and vibration in 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 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-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 D 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 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.

HVAC system filters are clean for TAB field work.

- i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the TAB field work.

#### 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-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.
- j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.
  - (1) TAB field visit: At the midpoint of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration.
  - (2) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.
- k. Certified TAB report: Certify the TAB report. This certification includes the following work:
  - (1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.
  - (2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.
- l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.
- m. TAB Field Check: The TAB team supervisor must attend and supervise TAB field check.

#### 1.5.5.4 TAB Team Field Leader

- a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."
- b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.
- c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

### 1.5.6 Test Reports

#### 1.5.6.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

- a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1972 CD. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.
- b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition, provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.
- c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.
- d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

#### 1.5.6.2 Certified TAB Reports

Submit: TAB Report for Season 1 and TAB Report for Season 2 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:

50A OFF 1A  
50B OFF 1B  
50 RECEPTION  
51 OFFICE 2  
52 OFFICE 3  
53 OFFICE 4  
54 OFFICE 5

57A OFFICE 6A  
57B OFFICE 6B  
57 OFFICE 6

- (1) Measure and compile data on a continuous basis for the period in which TAB work affecting those rooms is being done.
- (2) 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.
- (3) 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 TAB Report.

c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.

- (1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.
- (2) Report static pressure drop across DX coils.
- (3) Report static pressure drop across air filters.

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.

## 1.6 SEQUENCING AND SCHEDULING

### 1.6.1 TAB Submittal and Work Schedule

Comply with additional requirements specified in Appendix C: TAB SUBMITTAL AND WORK SCHEDULE included at the end of this section

### 1.6.2 TAB Submittal and Work Schedule

Submit this schedule, and TAB Schematic Drawings, adapted for this particular contract, to the Contracting Officer (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-TAB Meeting: Within 30 calendar days after the date of approval of the TAB agency and personnel, meet with the COTR.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field TAB Engineering Report: Within 90 calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List and Advanced Notice For TAB Field Work: At a minimum of 115 calendar days prior to CCD, submit prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of TAB field work.

TAB Field Work: At a minimum of 90 calendar days prior to CCD, accomplish TAB field work.

Submit TAB Report: Within 15 calendar days after completion of TAB field work, submit TAB report.

TAB Field Check: 30 calendar days after Season 1 TAB report is approved by the Contracting Officer, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work .

#### 1.6.2.1 Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

#### 1.6.2.2 Pre-Field TAB Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

- (1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.
- (2) Air System Diagrams: Use the contract drawings and duct fabrication drawings if available to provide air system diagrams in the report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagrams which identifies each outlet contained in the outlet airflow report sheets. Show intended locations of all traverses and static pressure readings.
- (3) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

b. Pre-field data: Submit AABC or NEBB or SMACNA 1780 data report forms

with the following pre-field information filled in:

- (1) Design data obtained from system drawings, specifications, and approved submittals.
  - (2) Notations detailing additional data to be obtained from the contract site by the TAB field team.
  - (3) Designate the actual data to be measured in the TAB field work.
  - (4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. Place the instrument key number in the blank space where the measured data would be entered.
- c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted and approved by the Contracting Officer prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" must be provided for each separate system to be TAB'd.

## 1.7 WARRANTY

Furnish workmanship and performance warranty for the TAB system work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB 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 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 2 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 TAB PROCEDURES

#### 3.2.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

That is, comply with the the requirements of AABC MN-1 and AABC MN-4, NEBB PROCEDURAL STANDARDS, NEBB MASV, or SMACNA 1780 (TABB) and SMACNA 1858 (TABB), except as supplemented and modified by this section.

Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

Test, adjust, and balance the HVAC systems until measured flow rates (air flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section.

#### 3.2.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

#### 3.2.3 TAB Air Distribution Systems

##### 3.2.3.1 Units With Coils

Report heating and cooling performance capacity tests for DX for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

##### 3.2.3.2 Makeup Air Units

Makeup air unit systems including fans, coils, ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

##### 3.2.3.3 Fan Coils

Fan coil unit systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

### 3.2.4 TAB Work on Performance Tests Without Seasonal Limitations

#### 3.2.4.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the cooling systems.

#### 3.2.4.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

#### 3.2.5 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

#### 3.2.6 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

#### 3.2.7 TAB Reports

Additional requirements for TAB Reports are specified in Appendix B REPORTS - DALT and TAB

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."



### 3.2.8 Quality Assurance - COTR TAB Field Acceptance Testing

#### 3.2.8.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (air quantities, air motion, ) 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: 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.

Group 2: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 3: 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.

#### 3.2.8.2 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.

#### 3.2.8.3 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.

### 3.3 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.

#### 3.4 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

#### 3.5 APPENDICES

Appendix A WORK DESCRIPTIONS OF PARTICIPANTS  
Appendix B REPORTS - DALT and TAB  
Appendix C DALT AND TAB SUBMITTAL AND WORK SCHEDULE  
Appendix D REQUIREMENTS FOR DUCT AIR LEAK TESTING

Appendix A

WORK DESCRIPTIONS OF PARTICIPANTS

The Contractor is responsible for ensuring compliance with all requirements of this specification section. However, the following delineation of specific work items is provided to facilitate and co-ordinate execution of the various work efforts by personnel from separate organizations.

1. Contractor
  - a. HVAC documentation: Provide pertinent contract documentation to the TAB Firm, to include the following: the contract drawings and specifications; copies of the approved submittal data for all HVAC equipment, air distribution devices, and air/water measuring/balancing devices; the construction work schedule; and other applicable documents requested by the TAB Firm. Provide the TAB Firm copies of contract revisions and modifications as they occur.
  - b. Schedules: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.
  - c. Pre-TAB meeting: Arrange and conduct the Pre-DALT and TAB meeting. Ensure that a representative is present for the sheet metal contractor, the mechanical contractor, the electrical contractor, and the automatic temperature controls contractor.
  - d. Coordinate Support: Provide and coordinate support personnel required by the TAB Firm in order to accomplish the TAB field work. Support personnel may include factory representatives, HVAC controls installers, HVAC equipment mechanics, sheet metal workers, pipe fitters, and insulators. Ensure support personnel are present at the work site at the times required.
  - e. Correct Deficiencies: Ensure the notifications of Construction Deficiencies are provided as specified herein. Refer to the paragraph entitled "Construction Deficiencies." Correct each deficiency as soon as practical with the Contracting Officer, and submit revised schedules and other required documentation.
  - f. Pre-TAB Work Checklists: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as pre-TAB work checklist items, the deficiencies pointed out by the TAB team supervisor in the design review report.

Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's TAB Work Procedures Summary. Do not allow the TAB team to commence TAB field work until all of the following are completed.

- g. Give Notice of Testing: Submit advance notice of TAB field work accompanied by completed prerequisite HVAC Work List

2. TAB Team Supervisor
  - a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical TAB procedures and TAB team field work.
  - b. Schedule: Ensure the requirements specified under the paragraph "TAB Schedule" are met.
  - c. Submittals: Provide the submittals specified herein.
  - d. Pre-TAB meeting: Attend meeting with Contractor. Ensure TAB personnel that will be involved in the TAB work under this contract attend the meeting.
  - e. Design Review Report: Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.
  - f. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the TAB Procedures Summary, during the TAB field work.

Ensure the Contractor is properly notified and aware of all support personnel needed to perform the TAB work. Maintain communication with the Contractor regarding support personnel throughout the duration of the TAB field work, including the TAB field acceptance testing checking.

Ensure all inspections and verifications for the Pre-TAB Checklists are completely and successfully conducted before TAB field work is performed.

- g. Technical Assistance: Provide technical assistance to the TAB field work.
- h. Deficiencies Notification: Ensure the notifications of Construction Deficiencies are provided as specified herein. Comply with requirements of the paragraph entitled "Construction Deficiencies." Resolve each deficiency as soon as practical and submit revised schedules and other required documentation.
- i. Procedures: Develop the required TAB procedures for systems or system components not covered in the TAB Standard.

3. TAB Team Field Leader

- a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."
- b. Full time: Be present at the contract site when TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

- c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC work list, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

Appendix B

REPORTS - TAB

All submitted documentation must be typed, neat, and organized. All reports must have a waterproof front and back cover, a title page, a certification page, sequentially numbered pages throughout, and a table of contents. Tables, lists, and diagrams must be titled. Generate and submit for approval the following documentation:

1. TAB Work Execution Schedule

Submit a detailed schedule indicating the anticipated calendar date for each submittal and each portion of work required under this section. For each work entry, indicate the support personnel (such as controls provider, HVAC mechanic, etc.) that are needed to accomplish the work. Arrange schedule entries chronologically.

2. TAB Procedures Summary

Submit a detailed narrative describing all aspects of the TAB field work to be performed. Include the following:

- a. A list of the intended procedural steps for the DALT and TAB field work from start to finish. Indicate how each type of data measurement will be obtained. Include what Contractor support personnel are required for each step, and the tasks they need to perform.
- b. A list of the project's submittals that are needed by the TAB Firm in order to meet this Contract's requirements.
- c. The schematic drawings to be used in the required reports, which may include building floor plans, mechanical room plans, duct system plans, and equipment elevations. Indicate intended TAB measurement locations, including where test ports need to be provided by the Contractor.
- d. The data presentation forms to be used in the report, with the preliminary information and initial design values filled in.
- e. A list of TAB instruments to be used, edited for this project, to include the instrument name and description, manufacturer, model number, scale range, published accuracy, most recent calibration date, and what the instrument will be used for on this project.
- f. A thorough checklist of the work items and inspections that need to be accomplished before the TAB field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-TAB Work Checklist before the TAB field work can be accomplished.
- h. The checklists specified above shall be individually developed and tailored specifically for the work under this contract. Refer to NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under the paragraphs titled, "Air Distribution System Inspection" for examples of items to include in the checklists.

3. Design Review Report

Submit report containing the following information:

- a. Review the contract specifications and drawings to verify that the TAB work can be successfully accomplished in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.
  - b. Submit a typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. If no deficiencies are evident, state so in the report.
4. TAB Reports: Submit TAB Report in the following manner:
- a. Procedure Summary: Submit a copy of the approved TAB Procedures Summary. When applicable, provide notations describing how actual field procedures differed from the procedures listed.
  - b. Report format: Submit the completed data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed, approved and signed by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.
  - c. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. 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) Data shall be measured and compiled on a continuous basis for the period in which TAB work affecting those rooms is being done.
    - (2) Data shall be measured/recorded only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode. Provide a detailed explanation wherever a final measurement did not achieve the required value.
    - (3) Data may be compiled using direct digital controls trend logging where available. Otherwise, the Contractor shall temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls shall have been fully operational a minimum of 24 hours in advance of commencing data compilation. The specified data shall be included in the TAB Report.
  - d. Air System Diagrams: Provided updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations.

e. Air Static Pressure Profiles: The static pressure report data shall include, in addition to AABC or NEBB or TABB required data, the following:

- (1) Report supply fan inlet and discharge static pressures.
- (2) Report static pressure drop across DX coils installed in unit cabinetry.

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.

- (3) Report static pressure drop across outside air louvers.
- (4) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Performance Curves: The TAB Supervisor shall include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

h. Calibration Curves: The TAB Supervisor shall include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturis and flow orifices TAB'd on the job.

i. Data From TAB Field Work: After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and approval signature, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."



Appendix C

TAB SUBMITTAL AND WORK SCHEDULE

Perform the following items of work in the order listed adhering to the dates schedule specified below.

Submit TAB Agency and TAB Personnel Qualifications: Within 42 calendar days after date of contract award.

Submit the TAB Work Execution Schedule: within 14 days after receipt of the TAB agency and TAB personnel qualifications approval. Revise and re-submit this schedule prior to the commencement of TAB work.

Submit the TAB Work Procedures Summary: within 14 days after receipt of the initial approved TAB Work Execution Schedule.

Meet with the COTR at the Pre-TAB Meeting: Within 28 calendar days after receipt of the approved initial TAB Execution Schedule.

Submit Design Review Report: Within 56 calendar days after the receipt of the approved initial TAB Work Execution Schedule.

Advance Notice of TAB Field Work: At a minimum of 14 calendar days prior to TAB Field Work, submit advance notice of TAB field work accompanied by completed Pre-TAB Work Checklist.

TAB Field Work: At a minimum of 84 calendar days prior to CCD, accomplish TAB field work.

Submit TAB Report: Within 14 calendar days after completion of TAB field work, submit initial TAB report.

Quality Assurance - COTR TAB Field Check: 30 calendar days after initial TAB report is approved by the Contracting Officer, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work and submit final.

Receive the approved TAB report: Within 21 calendar days, receive the report from Contracting Officer approved TAB report.

Appendix D		
REQUIREMENTS FOR DUCT AIR LEAK TESTING		
		SYSTEMS
		Outside AM Unit OAU-1
Duct System Static Pressure, in millimeters W.C.	for Supply	50
	for Outside Air	50
System Oval/Round Duct and Rectangular Duct SMACNA Seal Class	for Supply	A
	for Return	A
	for Outside Air	A
System Oval/Round Duct SMACNA Leak Class	for Supply	3
	for Outside Air	3

-- End of Section --

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS  
02/13

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. 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 2011-2014; Thru INT 24 2015)  
Energy Standard for Buildings Except  
Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

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 C1710 (2011) Standard Guide for Installation of  
Flexible Closed Cell Preformed Insulation  
in Tube and Sheet Form

ASTM C195 (2007; R 2013) Standard Specification for  
Mineral Fiber Thermal Insulating Cement

ASTM C450 (2008) Standard Practice for Fabrication  
of Thermal Insulating Fitting Covers for  
NPS Piping, and Vessel Lagging

ASTM C534/C534M (2014) Standard Specification for  
Preformed Flexible Elastomeric Cellular  
Thermal Insulation in Sheet and Tubular  
Form

ASTM C552 (2014) Standard Specification for Cellular  
Glass Thermal Insulation

ASTM C795 (2008; R 2013) Standard Specification for  
Thermal Insulation for Use in Contact with  
Austenitic Stainless Steel

ASTM C920 (2014a) Standard Specification for  
Elastomeric Joint Sealants

ASTM C921 (2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

ASTM D2863 (2013) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

ASTM D5590 (2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

ASTM E2231 (2015) Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics

ASTM E84 (2015a) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E96/E96M (2014) Standard Test Methods for Water Vapor Transmission of Materials

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide  
<http://www.approvalguide.com/>

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2758 (2014) Paper - Determination of Bursting Strength

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 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

UL 94 (2013; Reprint Jan 2015) Standard for  
Tests for Flammability of Plastic  
Materials for Parts in Devices and  
Appliances

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 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meet 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

Submit the following in accordance with contract requirements:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-03 Product Data

Pipe Insulation Systems;  
Duct Insulation Systems

SD-08 Manufacturer's Instructions

Pipe Insulation Systems

## Duct Insulation Systems

### 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, date codes, and approximate shelf life (if applicable). Insulation packages and containers shall be asbestos free.

## PART 2 PRODUCTS

### 2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

### 2.2 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. Submit 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 copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section 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.

#### 2.2.1 Insulation System

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 that are located within, on, under, and adjacent to buildings; and for plumbing systems. Provide CFC and HCFC free insulation.

### 2.2.2 Surface Burning Characteristics

Unless otherwise specified, insulation must 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 or UL 723. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Prepare and mount test specimens according to ASTM E2231.

### 2.3 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 systems. Materials shall be asbestos free. Provide product recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

#### 2.3.1 Adhesives

##### 2.3.1.1 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

##### 2.3.1.2 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. To resist mold/mildew, lagging adhesive shall meet ASTM D5590 with 0 growth rating. 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 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.

##### 2.3.1.3 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 E84. 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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide

product listed in FM APP GUIDE.

### 2.3.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

### 2.3.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

### 2.3.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. 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). For satisfactory performance, properly installed protective vapor retarder/barriers and vapor stops shall be used on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

### 2.3.5 Finishing Cement

ASTM C450: 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.

### 2.3.6 Jackets

#### 2.3.6.1 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.

#### 2.3.6.2 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

- a. On ducts, piping and equipment operating below 91 degrees F or located outside shall be equipped with a vapor barrier.



### 2.3.7 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 manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. 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. Flexible elastomerics require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

#### 2.3.7.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors if covered by a suitable protective jacket. The product shall meet all physical property and performance requirements of ASTM C1136, Type I, except the burst strength shall be a minimum of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) shall be a minimum of 31.

In addition, neither the outer exposed surface nor the inner-most surface contacting the insulation shall be paper or other moisture-sensitive material. The outer exposed surface shall be white and have an emittance of not less than 0.80. The outer exposed surface shall be paintable.

#### 2.3.7.2 Vapor Retarder/Vapor Barrier Mastic Coatings

##### 2.3.7.2.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84 flame and smoke requirements and shall be UV resistant.

#### 2.3.7.3 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 an excellent WVT rate.

#### 2.3.7.4 Vapor Barrier/Weather 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 ISO 2758. Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

#### 2.3.8 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

#### 2.3.9 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 permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

### 2.4 PIPE INSULATION SYSTEMS

Conform insulation materials to Table 1 and minimum insulation thickness as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1 - IP. Comply with EPA requirements for material with recycled content in accordance with Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS. Limit pipe insulation materials to those listed herein and meeting the following requirements:

#### 2.4.1 Aboveground Cold Pipeline ( -30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

##### 2.4.1.1 Cellular Glass

ASTM C552, Type II, and Type III. Supply the insulation from the fabricator with (paragraph WHITE VAPOR RETARDER ALL SERVICE JACKET (ASJ)) ASJ vapor retarder and installed with all longitudinal overlaps sealed and all circumferential joints ASJ taped or supply the insulation unfaced from the fabricator and install with all longitudinal and circumferential joints sealed with vapor barrier mastic.

##### 2.4.1.2 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II. Type I, Grade 1 for tubular materials. Type II, Grade 1, for sheet materials. Type I and II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation, and require an additional exterior vapor retarder covering for high relative humidity and below ambient temperature applications.

#### 2.4.2 Below-ground Pipeline Insulation

For below-ground pipeline insulation, use cellular glass, ASTM C552, type II.

## 2.5 DUCT INSULATION SYSTEMS

### 2.5.1 Factory Applied Insulation

#### 2.5.1.1 Blanket Insulation

Calculate minimum thickness in accordance with ASHRAE 90.1 - IP.

### 2.5.2 Duct Insulation Jackets

#### 2.5.2.1 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.

#### 2.5.2.2 Metal Jackets

##### 2.5.2.2.1 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.

##### 2.5.2.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

## 2.6 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 5 and 6. 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. Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the submitted MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. The instructions must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. A booklet is also required by paragraphs titled: Pipe Insulation Systems and Duct Insulation Systems.

## PART 3 EXECUTION

### 3.1 APPLICATION - GENERAL

#### 3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance

with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

### 3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials 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

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

#### 3.1.4.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive 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.

#### 3.1.4.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation 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.

### 3.1.5 Pipes/Ducts/Equipment That 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

Pipe insulation shall be continuous through the sleeve.

Provide 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 over the insulation wherever penetrations require sealing.

##### 3.2.1.2.1 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 plies 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.

### 3.2.1.2.2 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

### 3.2.1.3 Pipes Passing Through Hangers

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.

#### 3.2.1.3.1 Vertical Pipes

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.

#### 3.2.1.3.2 Inserts

Covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, overlap the adjoining pipe jacket 1-1/2 inches, and seal 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. Type II requires an additional exterior vapor retarder/barrier

covering for high relative humidity and below ambient temperature applications.

3.2.1.5 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1 and must meet or exceed the requirements of ASHRAE 90.1 - IP.

TABLE 1					
Insulation Material for Piping					
Service					
Material	Specification	Type	Class	VR/VB Req'd	
Refrigerant Suction Piping (35 degrees F nominal)					
Flexible Elastomeric Cellular	ASTM C534/C534M	I		No	
Cellular Glass	ASTM C552	II	1	Yes	
Condensate Drain Located Inside Building					
Flexible Elastomeric Cellular	ASTM C534/C534M	I		No	
Note: VR/VB = Vapor Retarder/Vapor Barrier					

TABLE 2						
Piping Insulation Thickness (inch)						
Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.						
Service						
Material	Tube And Pipe Size (inch)					
	<1	1-<1.5	1.5-<4	4-<8	> or = >8	
Refrigerant Suction Piping (35 degrees F nominal)						
Flexible Elastomeric Cellular	1	1	1	N/A	N/A	
Cellular Glass	1.5	1.5	1.5	1.5	1.5	
Condensate Drain Located Inside Building						
Flexible Elastomeric Cellular	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:

Refrigerant suction lines.

b. Air conditioner condensate drains.

### 3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

### 3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or 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, silver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic 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

Apply insulation to the pipe with tight butt joints. Seal all butted joints and ends with joint sealant and seal with a vapor retarder coating, greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

#### 3.2.2.3.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

#### 3.2.2.3.2 Laps and Butt Strips

Secure with adhesive and staple on 4 inch centers if not factory self-sealing. If staples are used, seal in accordance with paragraph STAPLES below. Note that staples are not required with cellular glass systems.

#### 3.2.2.3.3 Factory Self-Sealing Lap Systems

May be used when the ambient temperature is between 40 and 120 degrees F during installation. Install the lap system in accordance with manufacturer's recommendations. Use a stapler only if specifically recommended by the manufacturer. Where gaps occur, replace the section or



repair the gap by applying adhesive under the lap and then stapling.

#### 3.2.2.3.4 Breaks and Punctures in the Jacket Material

Patch by wrapping a strip of jacket material around the pipe and secure it with adhesive, staple, and coat with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Extend the patch not less than 1-1/2 inches past the break.

#### 3.2.2.3.5 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

#### 3.2.2.3.6 Flexible Elastomeric Cellular Pipe Insulation

Install 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. Secure all seams and butt joints and seal with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Push insulation on the pipe, never pulled. Stretching of insulation may result in open seams and joints. Clean cut all edges. Rough or jagged edges of the insulation are not be permitted. Use proper tools such as sharp knives. Do not stretch Grade 1, Type II sheet insulation around the pipe when used on pipe larger than 6 inches. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

#### 3.2.2.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow". Submit a booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.
  - (1) The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates shall present all variations of insulation systems including

locations, materials, vaporproofing, jackets and insulation accessories.

- (2) If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.
- 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.

### 3.2.3 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.

#### 3.2.3.1 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 metal jacketing/flashing sealant 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.

### 3.2.3.2 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 Below Ground Pipe Insulation

Below ground pipes shall be insulated in accordance with Table 2, except as precluded in subparagraph Pipe Insulation in PART 3. This includes, but is not limited to the following:

- a. Refrigerant Suction Lines.

#### 3.2.4.1 Type of Insulation

Below ground pipe shall be insulated with Cellular Glass insulation, in accordance with manufacturer's instructions for application with thickness as determined from Table 2 (whichever is the most restrictive).

#### 3.2.4.2 Installation of Below ground Pipe Insulation

- a. Bore surfaces of the insulation shall be coated with a thin coat of gypsum cement of a type recommended by the insulation manufacturer. Coating thickness shall be sufficient to fill surface cells of insulation. Mastic type materials shall not be used for this coating. Note that unless this is for a cyclic application (i.e., one that fluctuates between high and low temperature on a daily process basis) there is no need to bore coat the material.
- b. Stainless steel bands, 3/4 inch wide by 0.020 inch thick shall be used to secure insulation in place. A minimum of two bands per section of insulation shall be applied. As an alternate, fiberglass reinforced tape may be used to secure insulation on piping up to 12 inches in diameter. A minimum of two bands per section of insulation shall be applied.
- c. Insulation shall terminate at anchor blocks but shall be continuous through sleeves and manholes.
- d. At point of entry to buildings, underground insulation shall be terminated 2 inches inside the wall or floor, shall butt tightly against the aboveground insulation and the butt joint shall be sealed with high temperature silicone sealant and covered with fibrous glass tape.
- e. Provision for expansion and contraction of the insulation system shall be made in accordance with the insulation manufacturer's recommendations.

- f. Flanges, couplings, valves, and fittings shall be insulated with factory pre-molded, prefabricated, or field-fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. Insulation sections shall be secured as recommended by the manufacturer.
- g. Insulation, including fittings, shall be finished with three coats of asphaltic mastic, with 6 by 5.5 mesh synthetic reinforcing fabric embedded between coats. Fabric shall be overlapped a minimum of 2 inches at joints. Total film thickness shall be a minimum of 3/16 inch. As an alternate, a prefabricated bituminous laminated jacket, reinforced with internal reinforcement mesh, shall be applied to the insulation. Jacketing material and application procedures shall match manufacturer's written instructions. Vapor barrier - less than 0.0000 permeability self adhesive (minimum 2 mils adhesive, 3 mils embossed) jacket greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty, white or natural). Application procedures shall match the manufacturer's written instructions.
- h. At termination points, other than building entrances, the mastic and cloth or tape shall cover the ends of insulation and extend 2 inches along the bare pipe.

### 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. Duct insulation minimum thickness and insulation level must be as listed in Table 3 and must meet or exceed the requirements of ASHRAE 90.1 - IP.

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Duct insulation shall be omitted on exposed return ducts in air conditioned spaces unless otherwise shown. 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 Minimum Thickness

Duct insulation minimum thickness in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)	
Cold Air Ducts	2.0

#### 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.

Flexible run-outs (field-insulated).

- c. Plenums.
- d. Coil headers and return bends.
- e. Coil casings.
- f. Filter boxes.
- g. Mixing boxes (field-insulated).
- h. Supply fans (field-insulated).
- i. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

#### 3.3.2.1 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.

### 3.3.3 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.

-- 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. For New Construction and Major Revisions provide, also, documentation that meets EA Credit 3; Enhanced Commissioning. Provide documentation for as many LEED credits as possible to support LEED Silver certification of the project.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS. Submit the following in accordance with contract requirements:

#### SD-02 Shop Drawings

Commissioning Plan; G, AE, DO, S

#### SD-03 Product Data

Pre-Functional Performance Test Checklists; G, AE, DO, S  
Functional Performance Tests; G, AE, DO, S



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

Designation	Function
D	Design Agency Representative
O	Contracting Officer's Representative
U	Using Agency's Representative

Appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each Pre- Functional Performance Test Checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test item shall be indicated by signature and date.

### 3.2 TESTS

Perform the pre-functional performance test checklists and functional performance tests in a manner that essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, establish methods which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. Provide all materials, services, and labor required to perform the pre- functional performance tests checks and functional performance tests. A functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test.

#### 3.2.1 Pre-Functional Performance Test Checklists

Perform Pre-Functional Performance Test Checklists, for the items indicated in Appendix A, 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: All

Checklist Item	A	M	E	T	C	O
Installation						
a. Check condenser fans for proper rotation.	___	___	X	___	X	___
Electrical						
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. Unit safety/protection devices tested.	___	___	X	X	___	___
b. Control system and interlocks installed.	___	___	X	X	___	___
c. Control system and interlocks operational.	___	___	X	X	___	___

Pre-Functional Performance Test Checklist - Fan Coil Unit

For Fan Coil Unit: All

Checklist Item

Installation	A	M	E	T	C	O
a. Access doors/removable panels are operable and sealed.	___	___	X	___	X	___
b. Condensate drainage is unobstructed.	___	___	X	X	X	___
c. Fan belt adjusted.	___	___	X	___	X	___
Electrical	A	M	E	T	C	O
a. Power available to unit disconnect.	___	___	___	X	___	___
b. Power available to unit control panel.	___	___	___	X	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___
Controls	A	M	E	T	C	O
a. 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 - HVAC System Controls

For HVAC System: All

Checklist Item

Installation	A	M	E	T	C	O
a. Layout of control panel matches drawings.	___	___	X	X	___	___
b. Framed instructions mounted in or near control panel.	___	___	X	X	___	___
c. Components properly labeled (on inside and outside of panel).	___	___	X	X	___	___
d. Control components piped and/or wired to each labeled terminal strip.	___	___	X	X	___	___
e. Control wiring and tubing labeled at all terminations, splices, and junctions.	___	___	X	X	___	___

Main Power and Control Air

a. 120 volt AC power available to panel.	___	___	___	X	___	___
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Testing, Adjusting, and Balancing (TAB)	A	M	E	T	C	O
a. TAB Report submitted.	___	___	X	___	X	___



- End of Appendix A -

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

**Functional Performance Test Checklist - Air Cooled Condensing Unit**

For Condensing Unit:

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 fan coil unit. Verify control system energizes condensing unit start sequence. \_\_\_\_\_

b. Verify and record data in 2 and 3 below.

c. Shut off fan coil equipment to verify condensing unit de-energizes. \_\_\_\_\_

d. Restart fan coil 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.

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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

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**Functional Performance Test Checklist - Fan Coil Units**

The Contracting Officer will select fan coil units to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent. Hot water and chilled water systems must be in operation providing design water temperatures.

1. Functional Performance Test: Contractor shall demonstrate operation of selected fan coils in accordance with specifications including the following:

a. Cooling only fan coils:

(1) Verify fan coil unit response to room temp set point adjustment.

1. Check blower fan airflow. \_\_\_\_\_ cfm
2. Cooling mode inlet air temperature \_\_\_\_\_ deg F
3. Cooling mode outlet air temperature \_\_\_\_\_ deg F
4. Calculate coil sensible capacity and compare to design:  
Calculated \_\_\_\_\_ BTU/hr Design \_\_\_\_\_ BTU/hr

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Commissioning Specialist	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's TAB Representative	_____
Contractor's Controls Representative	_____
Design Agency Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____

**Functional Performance Test Checklist - HVAC Controls**

For HVAC System: All

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the Performance Verification Test (PVT) test for that system. Contractor to provide blank PVT test procedures previously done by the controls Contractor.

2. Verify interlock with UMCS system\_\_\_\_\_.

3. Verify all required I/O points function from the UMCS system\_\_\_\_\_.

4. Certification: We the undersigned have witnessed the Performance Verification Test 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 \_\_\_\_\_

Contractor's Officer's Representative \_\_\_\_\_

Using Agency's Representative \_\_\_\_\_

- End of Appendix B -

-End of document  
-- End of Section --



SECTION 23 23 00

REFRIGERANT PIPING  
10/07

PART 1 GENERAL

1.1 REFERENCES

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

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 710 I-P	(2009) Performance Rating of Liquid-Line Driers
AHRI 720	(2002) Refrigerant Access Valves and Hose Connectors
ANSI/AHRI 750	(2007) Thermostatic Refrigerant Expansion Valves
ANSI/AHRI 760	(2007) Performance Rating of Solenoid Valves for Use With Volatile Refrigerants

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

ANSI/ASHRAE 15 & 34	(2013; Addenda A 2014; ERTA 1 2014; ERTA 2 2015; INT 1 2015; ERTA 3 2015) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 17	(2008) Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding
AWS BRH	(2007; 5th Ed) Brazing Handbook
AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B16.22	(2013) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2013) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

ASME B31.1	(2014; INT 1-47) Power Piping
ASME B31.5	(2013) Refrigeration Piping and Heat Transfer Components
ASTM INTERNATIONAL (ASTM)	
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 B280	(2013) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B32	(2008; R 2014) Standard Specification for Solder Metal
ASTM B62	(2015) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2011) Standard Specification for Seamless Copper Tube
ASTM B813	(2010) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy 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)

## 1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-02 Shop Drawings

Refrigerant Piping System

SD-03 Product Data

Refrigerant Piping System  
Qualifications  
Refrigerant Piping Tests

Verification of Dimensions

SD-06 Test Reports

Refrigerant Piping Tests

SD-07 Certificates

Service Organization

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

Submit 6 copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations.

1.3.2 Contract Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation is the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

1.5 MAINTENANCE

1.5.1 General

Submit Data Package 2 plus operation and maintenance data complying with the contract requirements and as specified herein.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

2.2 STANDARD COMMERCIAL PRODUCTS

- a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

- b. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.
- c. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- d. Exposed equipment moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.
- e. Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include in the data manufacturer's recommended installation instructions and procedures. Provide data for the following components as a minimum:
  - (1) Piping and Fittings
  - (2) Valves
  - (3) Piping Accessories
  - (4) Pipe Hangers, Inserts, and Supports

### 2.3 ELECTRICAL WORK

Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Field wiring shall be in accordance with manufacturer's instructions.

### 2.4 REFRIGERANT PIPING SYSTEM

Refrigerant piping, valves, fittings, and accessories shall be in accordance with ANSI/ASHRAE 15 & 34 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories shall be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service shall be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant. Submit drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

- a. Piping layouts which identify all valves and fittings.

- b. Plans and elevations which identify clearances required for maintenance and operation.

## 2.5 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

### 2.5.1 Copper Tubing

Copper tubing shall conform to ASTM B280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inch and smaller may be flared. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62. Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B75/B75M. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

### 2.5.2 Solder

Solder shall conform to ASTM B32, grade Sb5, tin-antimony alloy for service pressures up to 150 psig. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B813.

### 2.5.3 Brazing Filler Metal

Filler metal shall conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

## 2.6 VALVES

Valves shall be designed, manufactured, and tested specifically for refrigerant service. Valve bodies shall be of brass or bronze construction. Valves 1 inch and smaller shall have brazed or socket welded connections. Valves larger than 1 inch shall have tongue-and-groove flanged end connections. Threaded end connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts shall be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere shall be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow shall be legibly and permanently indicated on the valve body. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

### 2.6.1 Refrigerant Stop Valves

Valve shall be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing shall be replaceable under line pressure. Valve shall be provided with a handwheel or wrench operator and a seal cap. Valve shall be the straight or angle pattern design as indicated.

#### 2.6.2 Check Valves

Valve shall be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve shall be provide with resilient seat.

#### 2.6.3 Liquid Solenoid Valves

Valves shall comply with ANSI/AHRI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 400 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

#### 2.6.4 Expansion Valves

Valve shall conform to ANSI/AHRI 750 and ASHRAE 17. Valve shall be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicted or for constant evaporator loads.

#### 2.6.5 Safety Relief Valves

Valve shall be the two-way type, unless indicated otherwise. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

#### 2.6.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable

suction pressure range.

#### 2.6.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with AHRI 720.

### 2.7 PIPING ACCESSORIES

#### 2.7.1 Filter Driers

Driers shall conform to AHRI 710 I-P. Sizes 5/8 inch and larger shall be the full flow, replaceable core type. Sizes 1/2 inch and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 1,500 psi.

#### 2.7.2 Vibration Dampeners

Dampeners shall be of the all-metallic bellows and woven-wire type.

#### 2.7.3 Flexible Pipe Connectors

Connector shall be a composite of interior corrugated phosphor bronze or Type 300 Series stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly shall be constructed with a safety factor of not less than 4 at 300 degrees F. Unless otherwise indicated, the length of a flexible connector shall be as recommended by the manufacturer for the service intended.

#### 2.7.4 Strainers

Strainers used in refrigerant service shall have brass or cast iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens shall be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

#### 2.7.5 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MSS SP-58.

#### 2.7.6 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

## PART 3 EXECUTION

### 3.1 EXAMINATION

After becoming familiar with all details of the work, perform a verification of dimensions in the field. Submit a letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found before

performing any work.

### 3.2 INSTALLATION

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation are not permitted without written approval. Cut pipe or tubing square, removed by reaming, and permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

#### 3.2.1 Directional Changes

Make changes in direction with fittings, except that bending of pipe 4 inches and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

#### 3.2.2 Functional Requirements

Piping shall be installed 1/2 inch/10 feet of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

#### 3.2.3 Fittings and End Connections

##### 3.2.3.1 Brazed Connections

Perform brazing in accordance with AWS BRH, except as modified herein. During brazing, fill the pipe and fittings with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, clean both the outside of the tube and the inside of the fitting with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Remove surplus brazing material at all joints. Make steel tubing joints in accordance with the manufacturer's recommendations. Paint joints in steel tubing with the same material as the baked-on coating within 8 hours after joints are made. Protect tubing against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Support piping prior to brazing and do not spring or force.

##### 3.2.3.2 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.



### 3.2.4 Valves

#### 3.2.4.1 General

Refrigerant stop valves shall be installed on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Stop valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensable gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

#### 3.2.4.2 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2-1/8 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2-1/8 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall be installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

#### 3.2.5 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the shaft of the compressor and shall be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

#### 3.2.6 Strainers

Strainers shall be provided immediately ahead of solenoid valves and expansion devices. Strainers may be an integral part of an expansion valve.

#### 3.2.7 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturer's recommendations for the system in which it is installed. Dryers shall be installed such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

#### 3.2.8 Flexible Pipe Connectors

Connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with

manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required.

### 3.2.9 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

#### 3.2.9.1 Hangers

Do not use Type 3 on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

#### 3.2.9.2 Inserts

Secure Type 18 inserts to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

#### 3.2.9.3 C-Clamps

Torque Type 19 and 23 C-clamps in accordance with MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

#### 3.2.9.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

#### 3.2.9.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

#### 3.2.9.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

#### 3.2.9.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet not more than 8 feet from end of risers, and at vent terminations.

#### 3.2.9.8 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

#### 3.2.9.9 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section.

#### 3.2.10 Pipe Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal. Detailed drawings of pipe anchors shall be submitted for approval before installation.

#### 3.2.11 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A653/A653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A53/A53M, Standard weight. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

##### 3.2.11.1 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07 92 00 JOINT SEALANTS.

##### 3.2.11.2 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07 84 00 FIRESTOPPING.

### 3.2.11.3 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

### 3.2.12 Field Applied Insulation

Field installed insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

## 3.3 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter shall be considered contaminated systems. Restoring contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, shall be performed using currently approved refrigerant and refrigeration manufacturer's procedures. Restoring contaminated systems shall be at no additional cost to the Government as determined by the Contracting Officer. Water shall not be used in any procedure or test.

## 3.4 REFRIGERANT PIPING TESTS

After all components of the refrigerant system have been installed and connected, subject the entire refrigeration system to pneumatic, evacuation, and startup tests as described herein. Submit a schedule, at least 2 weeks prior to the start of related testing, for each test. Identify the proposed date, time, and location for each test. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test. Provide the services of a qualified technician, as required, to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit 6 copies of the tests report in bound 8 1/2 by 11 inch booklets documenting all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

### 3.4.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

### 3.4.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the

source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ANSI/ASHRAE 15 & 34 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

#### 3.4.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

#### 3.4.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

#### 3.4.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the

remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

#### 3.4.6 Contractor's Responsibility

At all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

-- End of Section --

SECTION 23 31 13.00 40

METAL DUCTS

**11/12**

PART 1 GENERAL

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS apply to work specified in this section.

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2011) Steel Construction Manual

AISC 360 (2010) Specification for Structural Steel Buildings

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

ASHRAE EQUIP IP HDBK (2012) Handbook, HVAC Systems and Equipment (IP Edition)

ASHRAE FUN IP (2013; Addenda and Corrigendum 2013) Fundamentals Handbook, I-P Edition

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A36/A36M (2014) 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 A924/A924M (2014) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

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
- SMACNA 1987 (2006) HVAC Duct Systems Inspection Guide,  
3rd Edition

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

- SAE AMS 2480 (2009; Rev H) Phosphate Treatment, Paint,  
Base

1.2 SUBMITTALS

Submit the following in accordance with Scontract requirements:

SD-02 Shop Drawings

- Connection Diagrams
- Record Drawings
- Offset Fitting Configurations

SD-03 Product Data

- Equipment and Performance Data
- Galvanized Steel Ductwork Materials
- Round Sheet Metal Duct Fittings
- Turning Vanes
- Flexible Connectors
- Power Operated Dampers
- Manual Volume Dampers

1.3 RECORD DRAWINGS

Provide record drawings with current factual information. Include deviations from, and amendments to, the drawings and concealed or visible changes in the work, for medium/high pressure ductwork systems. Label drawings "As-Built".

PART 2 PRODUCTS

Include the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information within material, equipment, and fixture lists.

2.1 SYSTEM DESCRIPTION

Provide low-pressure systems ductwork and plenums where maximum air velocity is 2,000 feet per minute(fpm) and maximum static pressure is 2



inches water gage (wg), positive or negative.

Submit connection diagrams for low pressure ductwork systems indicating the relation and connection of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit design analysis and calculations for low pressure ductwork systems indicating the manufacturer's recommended air velocities, maximum static pressures, temperature calculations and acoustic levels.

#### 2.1.1 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### 2.2 MATERIALS

##### 2.2.1 Galvanized Steel Ductwork Materials

Provide hot-dip galvanized carbon steel ductwork sheet metal of lock-forming quality, with regular spangle-type zinc coating, conforming to ASTM A924/A924M and ASTM A653/A653M, Designation G90. Treat duct surfaces to be painted by apostatizing.

Conform to ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966 for sheet metal gages and reinforcement thickness.

Low pressure ductwork minimum standards are:

##### MINIMUM SHEET METAL GAGE

<u>DUCT WIDTH</u> <u>INCHES</u>	<u>GAGE</u>
0 - 12	26
13 - 30	24
31 - 60	22

##### 2.2.2 Mill-Rolled Reinforcing And Supporting Materials

Conform to ASTM A36/A36M for mill-rolled structural steel and, wherever in contact with sheet metal ducting galvanize to commercial weight of zinc or coated with materials conforming to ASTM A123/A123M .

In lieu of mill-rolled structural steel, submit for approval equivalent strength, proprietary design, rolled-steel structural support systems.

#### 2.3 COMPONENTS

##### 2.3.1 Round Sheet Metal Duct Fittings

Submit offset fitting configurations for approval. Shop fabricate fittings.

#### 2.3.1.1 Fittings Construction

Manufacture as separate fittings, not as tap collars welded or brazed into duct sections.

Provide two-piece type miter elbows for angles less than 31 degrees, three-piece type for angles 31 through 60 degrees, and five-piece type for angles 61 through 90 degrees. Ensure centerline radius of elbows is 1-1/2 times fitting cross section diameter.

Provide conical type crosses, increasers, reducers, reducing tees, and 90-degree tees.

Ensure cutouts in fitting body are equal to branch tap dimension or, where smaller, excess material is flared and rolled into smooth radius nozzle configuration.

#### 2.3.2 Reinforcement

Support inner liners of both duct and fittings by metal spacers welded in position to maintain spacing and concentricity.

#### 2.3.3 Fittings

Submit offset fitting configurations for approval.

Make divided flow fittings as separate fittings, not tap collars into duct sections, with the following construction requirements:

- a. Sound, airtight, continuous welds at intersection of fitting body and tap
- B. Tap liner securely welded to inner liner, with weld spacing not to exceed 3 inches
- c. Pack insulation around the branch tap area for complete cavity filling.
- d. Carefully fit branch connection to cutout openings in inner liner without spaces for air erosion of insulation and without sharp projections that cause noise and airflow disturbance.

Continuously braze seams in the pressure shell of fittings. Protect galvanized areas that have been damaged by welding with manufacturer's standard corrosion-resistant coating.

Construct two-piece type elbows for angles through 35 degrees, three-piece type for angles 36 through 71 degrees, and five-piece type for angles 72 through 90 degrees.

#### 2.3.4 Turning Vanes

Provide double-wall type turning vanes, commercially manufactured for high-velocity system service.

#### 2.3.5 Dampers

Construct low pressure drop, high-velocity manual volume dampers, and high-velocity fire dampers in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

### 2.3.6 Flexible Connectors For Sheet Metal

Use UL listed connectors, 30-ounce per square yard, waterproof, fire-retardant, airtight, woven fibrous-glass cloth, double coated with chloroprene. Clear width, not including clamping section, is 6 to 8 inches.

### 2.3.7 Duct Hangers

For duct hangers in contact with galvanized duct surfaces, provide galvanized steel painted with inorganic zinc.

### 2.3.8 Mill-Rolled Reinforcing And Supporting Materials

Provide mill-rolled structural steel conforming to ASTM A36/A36M. Whenever in contact with sheet metal ducting, provide galvanized steel in accordance with ASTM A123/A123M.

In lieu of mill-rolled structural steel, submit equivalent strength, proprietary-design, rolled-steel structural support systems for approval.

### 2.3.9 Manual Volume Dampers

Conform to SMACNA 1966 for volume damper construction.

Equip dampers with an indicating quadrant regulator with a locking feature externally located and easily accessible for adjustment and standoff brackets to allow mounting outside external insulation.

#### 2.3.9.1 Damper Construction

Provide all damper shafts with two-end bearings.

Provide a full length damper shaft and extend it beyond the damper blade. use a 3/8 inch square shaft for damper lengths up to 20 inches and a 1/2 inch square shaft for damper lengths 20 inches and larger. Where necessary to prevent damper vibration or slippage, provide adjustable support rods with locking provisions external to duct at damper blade end.

Provide dampers in ducts having a width perpendicular to the axis of the damper that is greater than 12 inches of multiblade type having a substantial frame with blades fabricated of 16 -gage metal. Provide blades not exceeding 10 inches in width and 48 inches in length, welded to 1/2 inch diameter shafts. Ensure dampers greater than 48 inches in width are made in two or more sections with intermediate mullions, each section being mechanically interlocked with the adjoining section or sections. Provide blades with oil-impregnated sintered bronze bearings and connect so that adjoining blades rotate in opposite directions.

### 2.3.10 Gravity Backdraft And Relief Dampers

#### 2.3.10.1 Blade Construction

Maximum blade width is 9 inches, and maximum blade length is 36 inches. Blade material is 16-gage galvanized steel . Provide blades with mechanically retained seals and 90-degree limit stops.

Blades linked together for relief service dampers are to open not less than 30 degrees on 0.05 inch wg differential pressure.

### 2.3.11 Power-Operated Dampers

Ensure dampers conform to applicable requirements specified under Division 26 - Electrical.

## PART 3 EXECUTION

### 3.1 PREPARATION

For sheet metal surfaces to be painted, and surfaces to which adhesives are to be applied, clean surface of oil, grease, and deleterious substances.

Ensure strength is adequate to prevent failure under service pressure or vacuum created by fast closure of duct devices. Provide leaktight, automatic relief devices.

#### 3.1.1 Construction Standards

Provide sheet metal construction in accordance with the recommendations for best practices in ASHRAE EQUIP IP HDBK, Chapter 16, SMACNA 1966, NFPA 90A, and ASHRAE FUN IP, Chapter 32.

Design and fabricate supplementary steel in accordance with AISC 360 and AISC 325.

Where construction methods for certain items are not described in the referenced standards or herein, perform the work in accordance with recommendations for best practice defined in ASHRAE EQUIP IP HDBK.

### 3.2 INSTALLATION

Fabricate airtight and include reinforcements, bracing, supports, framing, gasketing, sealing, and fastening to provide rigid construction and freedom from vibration, airflow-induced motion and noise, and excessive deflection at specified maximum system air pressure and velocity.

Provide offsets and transformations as required to avoid interference with the building construction, piping, or equipment.

Make plenum anchorage provisions, sheet metal joints, and other areas airtight and watertight by caulking mating galvanized steel and concrete surfaces with a two-component elastomer.

#### 3.2.1 Jointing

Enclose dampers located behind architectural intake or exhaust louvers by a rigid sheet metal collar and sealed to building construction with elastomers for complete air tightness.

Provide outside air-intake ducts and plenums made from sheet metal with soldered watertight joints.

#### 3.2.2 Ducts

Wherever ducts pass through firewalls or through walls or floors dividing conditioned spaces from unconditioned spaces, provide a flanged segment in that surface during surface construction.

Where interiors of ducting may be viewed through air diffusion devices, construct the viewed interior with sheet metal and paint flat black.

### 3.3 APPLICATION

#### 3.3.1 Low Pressure Sheet Metal Ducts

Weld angle iron frames at corners and ends, whenever possible. Rivet or weld angle iron reinforcements to ducts not more than 6 inches on center, with not less than two points of attachment. Spot welding, where used, is 3 inches on center.

Seal standard seam joints with an elastomer compound to comply with SMACNA 1966 Seal Class A, B or C as applicable.

Limit crossbreaking to 4 feet and provide on all ducts 8 inches wide and wider. Provide bead reinforcement in lieu of crossbreaking where panel popping may occur. Where rigid insulation is applied, crossbreaking is not required.

##### 3.3.1.1 Longitudinal Duct Seams

Provide Pittsburgh lock corner seams.

##### 3.3.1.2 Joints and Gaskets

Bolt companion angle flanges together with 1/4 inch diameter bolts and nuts spaced 6 inches on center. Gasket flanged joints with chloroprene full-face gaskets 1/8 inch thick, with Shore A 40 durometer hardness. Use one piece gaskets, vulcanized at joints.

##### 3.3.1.3 Square Elbows

Provide single-vane duct turns in accordance with SMACNA 1966, use on ducts 12 inches in width and narrower.

Provide double-vane duct turns in accordance with SMACNA 1966.

##### 3.3.1.4 Radius Elbows

Conform to SMACNA 1966 for radius elbows. Provide an inside radius equal to the width of the duct. Where installation conditions preclude use of standard elbows, the inside radius may be reduced to a minimum of 0.25 times duct width and install turning vanes in accordance with the following schedule.

WIDTH OF ELBOWS INCHES	RADIUS OF TURNING VANES IN PERCENT OF DUCT WIDTH		
	VANE NO. 1	VANE NO. 2	VANE NO. 3
	Up to 16	56	--
17 to 48	43	73	--
49 and over	37	55	83

Where two elbows are placed together in the same plane in ducts 30 inches wide and larger, continue the guide vanes through both elbows rather than spaced in accordance with above schedule.

### 3.3.1.5 Outlets, Inlets, And Duct Branches

Install branches, inlets, and outlets so that air turbulence is reduced to a minimum and air volume properly apportioned. Install adjustable splitter dampers at all supply junctions to permit adjustment of the amount of air entering the branch. Wherever an air-diffusion device is shown as being installed on the side, top, or bottom of a duct, and whenever a branch takeoff is not of the splitter type; provide a commercially manufactured 45 degree side-take-off (STO) fitting with manual volume damper to allow adjustment of the air quantity and to provide an even flow of air across the device or duct it services.

### 3.3.1.6 Duct Transitions

Where the shape of a duct changes, ensure the angle of the side of the transition piece does not exceed 15 degrees from the straight run of duct connected thereto.

### 3.3.1.7 Branch Connections

Construct radius tap-ins in accordance with SMACNA 1966.

### 3.3.1.8 Plenum Construction

Provide intake and discharge plenum companion angle joints with the following minimum thickness of materials:

<u>LONGEST</u> <u>ANGLES</u> <u>SIDE</u> <u>INCHES</u>	<u>SHEET</u> <u>METAL</u> <u>USS GAGE</u> <u>ALL SIDES</u>	<u>COMPANION ANGLES</u> <u>INCHES</u>	<u>REINFORCEMENT</u> <u>INCHES, 24 INCHES ON</u> <u>CENTER MAXIMUM</u>
To 48	20	1-1/2 by 1-1/2 by 1/8	1-1/2 by 1-1/2 by 1/8
49 to 84	18	2 by 2 by 1/8	2 by 2 by 3/16
85 to 120	16	2 by 2 by 1/8	2 by 2 by 1/8
121 and larger	14	2 by 2 by 3/16	2 by 2 by 3/16

### 3.3.1.9 Plenum Door Construction

Construct plenum access doors in accordance with SMACNA 1966 except that access doors smaller than man-access doors have door openings framed with angle iron that is one commercial size smaller than the specified panel reinforcement.

Ensure man-access door size conforms to per SMACNA 1966 and paragraph ACCESS OPENINGS.

### 3.3.1.10 Manual Volume Dampers

Provide balancing dampers of the splitter, butterfly, or multilouver type, to balance each respective main and branch duct.

For dampers regulated through ceilings provide a regulator concealed in a

box mounted in the ceiling, with a cover finish aesthetically compatible with ceiling surface. Where ceiling is of removable construction, set regulators above the ceiling, and mark the location on ceiling in a manner acceptable to the Contracting Officer.

#### 3.3.1.11 Flexible Connectors For Sheet Metal

Connect air handling equipment, ducts crossing building expansion joints, and fan inlets and outlets to upstream and downstream components by treated woven-cloth connectors.

Install connectors only after system fans are operative, and vibration isolation mountings have been adjusted. When system fans are operating, ensure connectors are free of wrinkle caused by misalignment or fan reaction. Width of surface is curvilinear.

#### 3.3.2 Rectangular Sheet Metal Ducts

##### 3.3.2.1 Duct Branch Transition

Where a duct branch handles over 25 percent of the air transported by the duct main, use a complete 90-degree increasing, with an inside radius of 0.75 times duct branch width. Ensure the size of the trailing end of the increasing elbow within the main duct is in the same ratio to the main duct size as the ratio of the relative air quantities handled.

Where a duct branch is to handle 25 percent or less of the air handled by the duct main, provide a branch connection with an inside radius of 0.75 times branch duct width, a minimum arc length of 45 degrees, and an outside radius of 1.75 times duct branch width. Place arc tangent to duct main.

#### 3.3.3 Round Sheet Metal Ducts

##### 3.3.3.1 Duct Gages And Reinforcement

Sheet metal minimum thickness, joints, and reinforcement between joints shall be in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

Continuously weld flanges to duct on outside of duct and intermittently welded with 1 inch welds every 4 inches on inside joint face. Remove excess filler metal from inside face. Protect galvanized areas that have been damaged by welding with manufacturer's standard corrosion-resistant coating.

##### 3.3.3.2 Duct Joints

Provide duct joints manufactured by machine, with spiral locksets to and including 60 inch diameters, and to dimensional tolerances compatible with fittings provided. Draw band girth joints are not acceptable.

Prepare slip joints by coating the male fitting with elastomer sealing materials, exercising care to prevent mastic from entering fitting bore, leaving only a thin annular mastic line exposed internally. Use sheet metal screws to make assembly rigid, not less than four screws per joint, maximum spacing 6 inches. Do not use pop rivets. Tape and heat seal all joints.

#### 3.3.3.3 Duct Transitions

Where the shape of a duct changes, ensure the angle of the side of the transition piece does not exceed 15 degrees from the straight run of duct connected thereto.

Where equipment is installed in ductwork, ensure the angle of the side of the transition piece from the straight run of duct connected thereto does not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

#### 3.3.4 Joint Gaskets

Gasket flanged joints with chloroprene full-face gaskets 1/8 inch thick, Shore A 40 durometer hardness. Use one-piece gaskets, vulcanized at joints.

#### 3.3.5 Radius Elbows

Fabricate elbow proportions and radius elbows in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

#### 3.3.6 Plenum Connections

Ensure round duct connections are welded joint bellmouth type.

Ensure rectangular duct connections are bellmouth type, constructed in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966.

#### 3.3.7 Duct Supports

Install duct support in accordance with ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Meet the minimum size for duct hangers as specified in ASHRAE EQUIP IP HDBK, Chapter 16, ASHRAE FUN IP, Chapter 32 and SMACNA 1966. Provide two hangers where necessary to eliminate sway. Support attachment to duct surfaces by solid rivet or bolt 4 inches on center.

Take the following into account in selection of a hanging system:

- a. Location and precedence of work under other sections
- b. Interferences of various piping and electrical conduit
- c. Equipment, and building configuration
- d. Structural and safety factor requirements
- e. Vibration, and imposed loads under normal and abnormal service conditions

Support sizes, configurations, and spacing are given to show the minimal type of supporting components required. If installed loads are excessive for the specified hanger spacing, hangers, and accessories reduce hanger spacing. After system startup, replace any duct support device which, due to length, configuration, or size, vibrates or causes possible failure of a member, or the condition otherwise be alleviated. Exercise special care to preclude cascade-type failures.



Do not hang ductwork and equipment from roof deck, piping, or other ducts or equipment. Maximum span between any two points is 10 feet, with lesser spans as required by duct assemblies, interferences, and permitted loads imposed.

#### 3.3.7.1 Hangars

Attach hanger rods, angles, and straps to beam clamps. Receive approval from the Contracting Officer for concrete inserts, masonry anchors, and fasteners for the application.

Hardened high-carbon spring-steel fasteners fitted onto beams and miscellaneous structural steel are acceptable upon prior approval of each proposed application and upon field demonstration of conformance to specification requirements. Make fasteners from steel conforming to AISI Type 1055, treated and finished in conformance with SAE AMS 2480, Type Z (zinc phosphate base), Class 2 (supplementary treatment). Verify a 72-hour load-carrying capacity by a certified independent laboratory.

Where ductwork system contains heavy equipment, excluding air-diffusion devices and single-leaf dampers, hang such equipment independently of the ductwork by means of rods or angles of sizes adequate to support the load.

Sufficiently cross-brace hangers to eliminate swaying both vertically and laterally.

#### 3.3.7.2 Installation

Ensure hanger spacing gives a 20-to-1 safety factor for supported load.

Maximum load supported by any two fasteners is 100 pounds.

Install hangers on both sides of all duct turns, branch fittings, and transitions.

Friction rod assemblies are not acceptable.

#### 3.3.7.3 Strap-type Hangars

Support rectangular ducts up to 36 inches by strap-type hangers attached at not less than three places to not less than two duct surfaces in different planes.

Perforated strap hangers are not acceptable.

#### 3.3.7.4 Trapeze Hangars

Support rectangular ducting, 36 inches and larger, by trapeze hangers. Support ducts situated in unconditioned areas and required to have insulation with a vapor-sealed facing on trapeze hangers. Space hangers far enough out from the side of the duct to permit the duct insulation to be placed on the duct inside the trapeze. Do not penetrate the vapor-sealed facing with duct hangers.

Where trapeze hangers are used, support the bottom of the duct on angles sized as follows:

<u>WIDTH OF DUCT, INCHES</u>	<u>MINIMUM BOTTOM ANGLE SIZE, INCHES</u>
30 and smaller	1-1/4 by 1-1/4 by 1/8
31 to 48	1-1/2 by 1-1/2 by 1/8
49 to 72	1-1/2 by 1-1/2 by 3/16
73 to 96	2 by 2 by 1/4
97 and wider	3 by 3 by 1/4

### 3.3.7.5 Purlins

Do not support ducting, when supported from roof purlins, at points greater than one-sixth of the purlin span from the roof truss. Do not exceed 400 pounds load per hanger when support is from a single purlin or 800 pounds when hanger load is applied halfway between purlins by means of auxiliary support steel provided under this section. When support is not halfway between purlins, the allowable hanger load is the product of 400 times the inverse ratio of the longest distance of purlin-to-purlin spacing.

When the hanger load exceeds the above limits, provide reinforcing of purlin(s) or additional support beam(s). When an additional beam is used, have the beam bear on the top chord of the roof trusses, and also bear over the gusset plates of top chord. Stabilize the beam by connection to roof purlin along bottom flange.

Purlins used for supporting fire-protection sprinkler mains, electrical lighting fixtures, electrical power ducts, or cable trays are considered fully loaded. Provide supplemental reinforcing or auxiliary support steel for these purlins.

### 3.3.8 Flexible Connectors For Steel Metal

Connect air-handling equipment, ducts crossing building expansion joints, and fan inlets and outlets to upstream and downstream components by treated woven-cloth connectors.

Install connectors only after system fans are operative and all vibration isolation mountings have been adjusted. When system fans are operating, ensure connectors are free of wrinkles caused by misalignment or fan reaction. Width of surface is curvilinear.

### 3.3.9 Insulation Protection Angles

Provide galvanized 20-gage sheet, formed into an angle with a 2 inch exposed long leg with a 3/8 inch stiffening break at outer edge, and with a variable concealed leg, depending upon insulation thickness.

Install angles over all insulation edges terminating by butting against a wall, floor foundation, frame, and similar construction. Fasten angles in place with blind rivets through the protection angle, insulation, and sheet metal duct or plenum. Install angles after final insulation covering has been applied.

### 3.3.10 Duct Probe Access

Provide holes with neat patches, threaded plugs, or threaded or twist-on caps for air-balancing pitot tube access. Provide extended-neck fittings where probe access area is insulated.

### 3.3.11 Openings In Roofs And Walls

Building openings are fixed and provide equipment to suit.

## 3.4 FIELD QUALITY CONTROL

## 3.5 DUCTWORK CLEANING PROVISIONS

Protect open ducting from construction dust and debris in a manner approved by the Contracting Officer. Clean dirty assembled ducting by subjecting all main and branch interior surfaces to airstreams moving at velocities two times specified working velocities, at static pressures within maximum ratings. This may be accomplished by: filter-equipped portable blowers which remain the Contractor's property; wheel-mounted, compressed-air operated perimeter lances which direct the compressed air and which are pulled in the direction of normal airflow; or other means approved by the Contracting Officer. Use water- and oil- free compressed air for cleaning ducting. After construction is complete, and prior to acceptance of the work, remove construction dust and debris from exterior surfaces. Clean in conformance with SMACNA 1987.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS  
07/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2014) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 02, EXISTING CONDITIONS, Division 11, EQUIPMENT, Division 13, SPECIAL CONSTRUCTION, and Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

Section 26 51 00 INTERIOR LIGHTING

Section 26 56 00 EXTERIOR LIGHTING

Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM

### 1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

### 1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 120/208V three phase, four wire, 60 Hz. Final connections to the power distribution system at the existing panelboard(s) shall be made by the Contractor as directed by the Contracting Officer.

### 1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

#### 1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

#### 1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

### 1.6 QUALITY ASSURANCE

#### 1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers

regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

#### 1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

#### 1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### 1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

#### 1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's

name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

#### 1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPS0710D72 or approved equal.
- b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

#### 1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

#### 1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.2.2 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --



SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL  
**08/13**

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.

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2013) Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480 (1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28 (2014) Standard for Pad-Mounted Equipment  
- Enclosure Integrity

IEEE C57.12.29 (2014) Standard for Pad-Mounted Equipment  
- Enclosure Integrity for Coastal  
Environments

IEEE Stds Dictionary (2009) IEEE Standards Dictionary: Glossary  
of Terms & Definitions

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1 (2009) Accessible and Usable Buildings and  
Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1 (2006; R 2011) American National Standard  
for Safety--Color Code

ANSI/NEMA OS 1 (2013) Sheet-Steel Outlet Boxes, Device  
Boxes, Covers, and Box Supports

NEMA 250 (2014) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

NEMA FB 1 (2012) Standard for Fittings, Cast Metal  
Boxes, and Conduit Bodies for Conduit,  
Electrical Metallic Tubing, and Cable

NEMA KS 1 (2013) Enclosed and Miscellaneous  
Distribution Equipment Switches (600 V  
Maximum)

NEMA PB 1 (2011) Panelboards

NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2013) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 1	(2009) Standard for Metal Cable Tray Systems
NEMA WD 1	(1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2012) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2012) Standard for Flexible Metal Conduit
UL 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 489	(2013; Reprint Mar 2014) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 797	(2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel
UL 870	(2008; Reprint Feb 2013) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.
- b. The technical sections referred to herein are those specification

sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

### 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. 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-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists

#### SD-03 Product Data

Conduits and Raceways

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Panelboards

Lamps and Lighting Fixtures

#### SD-06 Test Reports

Insulation Resistance Test

#### SD-07 Certificates

Certification

#### SD-08 Manufacturer's Instructions

Manufacturer's Instructions

### 1.4 QUALITY ASSURANCE

Submit certification required to install equipment components and system packages.

## PART 2 PRODUCTS

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special provisions detail impedances, hazards and safety precautions.

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

### 2.1 EQUIPMENT

Provide the standard cataloged materials and equipment of manufacturers regularly engaged in the manufacture of the products. For material, equipment, and fixture lists submittals, show manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

#### 2.1.1 Conduits And Raceways

##### 2.1.1.1 Rigid Steel Conduit

Ensure rigid steel conduit complies with UL 6 and is galvanized by the hot-dip process. Use polyvinylchloride (PVC) coated rigid steel conduit in accordance with NEMA RN 1, where underground and in corrosive areas, or painted with bitumastic.

Use threaded fittings for rigid steel conduit.

Use solid gaskets. Ensure conduit fittings with blank covers have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Ensure covers have captive screws and are accessible after the work has been completed.

##### 2.1.1.2 Electrical Metallic Tubing (EMT)

Ensure EMT is in accordance with UL 797 and is zinc coated steel. Provide zinc-coated couplings and connectors that are raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

##### 2.1.1.3 Flexible Metallic Conduit

Ensure flexible metallic conduit is galvanized steel and complies with UL 1.

Ensure fittings for flexible metallic conduit are specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

##### 2.1.1.4 Intermediate Metal Conduit

Ensure intermediate metal conduit is galvanized steel and complies with UL 1242.

#### 2.1.1.5 Rigid Nonmetallic Conduit

Ensure rigid nonmetallic conduit complies with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

#### 2.1.1.6 Wireways and Auxiliary Gutters

Ensure wireways and auxiliary gutters are a minimum 4 by 4-inch trade size conforming to UL 870.

#### 2.1.1.7 Surface Raceways and Assemblies

Ensure surface metal raceways and multi-outlet assemblies conform to NFPA 70. Receptacles conform to NEMA WD 1, Type 5-15R.

#### 2.1.2 Cable Trays

Provide ladder type cable trays conforming to NEMA VE 1.

#### 2.1.3 Wire and Cable

Use copper 600-volt type THWN for conductors installed in conduit. Ensure all conductors AWG No. 8 and larger, are stranded. All conductors smaller than AWG No. 8 are solid.

Ensure flexible cable is Type SO and contain a grounding conductor with green insulation.

Ensure conductors installed in plenums are marked plenum rated.

#### 2.1.4 Switches

##### 2.1.4.1 Safety Switches

Ensure safety switches comply with NEMA KS 1, and are the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction is such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device is coinproof and so constructed that an external tool is used to open the cover. Make provisions to lock the handle in the "OFF" position. Ensure the switch is not capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Ensure safety color coding for identification of safety switches conforms to ANSI Z535.1.

##### 2.1.4.2 Toggle Switches

Ensure toggle switches comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and are the heavy duty, general purpose, noninterchangeable flush-type.

Provide commercial grade toggle switches, single-pole, rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

Ensure all toggle switches are products of the same manufacturer.

#### 2.1.5 Receptacles

Provide commercial grade receptacles, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

#### 2.1.6 Outlets, Outlet Boxes, and Pull Boxes

Ensure outlet boxes for use with conduit systems are in accordance with NEMA FB 1 and ANSI/NEMA OS 1 and are not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

#### 2.1.7 Panelboards

Provide circuit breaker type lighting and appliance branch circuit panelboards in accordance with NEMA PB 1. Bolt circuit breakers to the bus. Plug-in circuit breakers are not acceptable. Provide copper buses of the rating indicated, with main lugs or main circuit breaker as indicated. Provide all panelboards for use on grounded ac systems with a full-capacity isolated neutral bus and a separate grounding bus bonded to the panelboard enclosure. Ensure panelboard enclosures are NEMA 250, Type 1, in accordance with NEMA PB 1. Provide enclosure fronts with latchable hinged doors.

#### 2.1.8 Circuit Breakers

Ensure circuit-breaker interrupting rating is not less than those indicated and in no event less than 10,000 amperes root-mean-square (rms) symmetrical at 208 volts, respectively. Multipole circuit breakers are the common-trip type with a single handle. Molded case circuit breakers are bolt-on type conforming to UL 489.

#### 2.1.9 Lamps and Lighting Fixtures

Manufacturers and catalog numbers shown are indicative of the general type desired and are not intended to restrict the selection to fixtures of any particular manufacturer. Fixtures with the same salient features and equivalent light distribution and brightness characteristics, of equal finish and quality, are acceptable. Provide lamps of the proper type and wattage for each fixture.

Ensure ballasts have a high power factor and be energy efficient. Provide ballasts with a Class P terminal protective device for 120-volt operation as indicated and are rapid-start fluorescent. Ballasts are "A" sound rated. Provide standard reduced wattage type fluorescent lamps.

Provide high intensity discharge (HID) lighting fixtures that have prewired integral ballasts and cast aluminum housings complete with tempered glass lenses suitable for installation in damp or wet locations. Provide fixtures and lamps.

#### 2.1.10 Manufacturer's Nameplate

Ensure each item of equipment has 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 is not acceptable.

### 2.1.11 Warning Signs

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to conform with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Provide decal signs with nominal dimensions of 7 by 10 inches. Print the legend "DANGER HIGH VOLTAGE" in two lines of nominal 2 inch high letters. Show the word "DANGER" in white letters on a red background and the words "HIGH VOLTAGE" in black letters on a white background. Use Panduit decal No. PPSO710D72 or approved equal.
- b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

## PART 3 EXECUTION

### 3.1 PREPARATION

Clean and paint conduit, supports, fittings, cabinets, pull boxes, and racks as specified in Section 09 90 00 PAINTS AND COATINGS or Section 09 96 00 HIGH-PERFORMANCE COATINGS.

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Provide hot-dip galvanized ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous not of corrosion-resistant steel except where other equivalent protective treatment is specifically approved in writing.

### 3.2 INSTALLATION

#### 3.2.1 Conduits, Raceways And Fittings

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting cannot contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

#### 3.2.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Use long radius conduit for elbows larger than 2-1/2 inches.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor. For conduits installed for future use, terminate with a coupling and plug set flush with the floor.

#### 3.2.1.2 Electrical Metallic Tubing (EMT)

Ground EMT in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

#### 3.2.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Use bonding wires in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit is not considered a ground conductor.

Make electrical connections to vibration-isolated equipment with flexible metallic conduit.

Use liquidtight flexible metallic conduit in wet and oily locations and to complete the connection to motor-driven equipment.

#### 3.2.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only for indoor installations.

#### 3.2.1.5 Rigid Nonmetallic Conduit

Ensure rigid PVC conduit is direct buried.

Install a green insulated copper grounding conductor in conduit with conductors and solidly connect to ground at each end. Size grounding wires in accordance with NFPA 70.

#### 3.2.1.6 Wireway and Auxiliary Gutter

Bolt together straight sections and fittings to provide a rigid, mechanical connection and electrical continuity. Close dead ends of wireways and auxiliary gutters. Plug all unused conduit openings.

Support wireways for overhead distribution and control circuits at maximum 5-foot intervals.

Ensure auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure contains no switches, overcurrent devices, appliances, or apparatus and is not more than 30 feet long.



### 3.2.1.7 Surface Raceways and Assemblies

Mount surface raceways plumb and level, with the base and cover secured. Minimum circuit run is three-wire, with one wire designated as ground.

### 3.2.1.8 Cable Trays

Support cable trays from ceiling hangers, equipment bays, or floor or wall supports. Cable trays may be mounted on equipment racks. Provide support when the free end extends beyond 3 feet. Maximum support spacing is 6 feet. Support trays 10-inches wide or less by one hanger. Support trays greater than 10-inches wide by two hangers. Bond cable trays at splices.

### 3.2.1.9 Splices and Connectors

Make all splices in AWG No. 8 and smaller with approved insulated electrical type.

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools. Wrap joints with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

### 3.2.2 Wiring

Color code feeder and branch circuit conductors as follows:

CONDUCTOR	COLOR AC
Phase A	Match Existing
Phase B	Match Existing
Phase C	Match Existing
Neutral	White
Equipment Grounds	Green

Use conductors up to and including AWG No. 2 that are manufactured with colored insulating materials. For conductors larger than AWG No. 2, have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Match terminal and conductor identification as indicated.

Where several feeders pass through a common pullbox, tag the feeders to clearly indicate the electrical characteristics, circuit number, and panel designation.

### 3.2.3 Safety Switches

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible

location or where the passageway to the switch may become obstructed.  
Mounting height 5 feet above floor level, when possible.

### 3.2.4 Wiring Devices

#### 3.2.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates are aligned vertically to within 1/16 inch.

Bond ground terminal of each flush-mounted receptacle to the outlet box with an approved green bonding jumper when used with dry wall type construction.

#### 3.2.4.2 Device Plates

Ensure device plates for switches that are not within sight of the loads controlled suitably engraved with a description of the loads.

Mark device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking consists of a self-adhesive label having 1/4 inch embossed letters.

Similarly mark device plates for convenience outlets indicating the supply panel and circuit number.

#### 3.2.5 Boxes and Fittings

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. For conduit runs longer than 100 feet or with more than three right-angle bends, install a pullbox at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Select the mounting height of wall-mounted outlet and switch boxes, as measured between the bottom of the box and the finished floor, in accordance with ICC/ANSI A117.1 and as follows:

LOCATION	MOUNTING HEIGHT
Receptacles in offices	18 inches
Receptacles in corridors	18 inches
Receptacles in shops and laboratories	48 inches
Receptacles in rest rooms	48 inches
Switches for light control	48 inches

#### 3.2.6 Lamps and Lighting Fixtures

Install new lamps of the proper type and wattage in each fixture. Securely

fasten fixtures and supports to structural members and install parallel and perpendicular to major axes of structures.

### 3.2.7 Panelboards

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor. Do not mount equipment within 36 inches of the front of the panel. Ensure directory card information is complete and legible.

### 3.2.8 Field Fabricated Nameplates

Ensure nameplates conform to ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device, as specified in the technical sections or as indicated on the drawings. Each nameplate inscription identifies the function and, when applicable, the position. Provide nameplates that are melamine plastic, 0.125 inch thick, white with black center core and a matte finish surface with square corners. Accurately align lettering and engrave into the core. Minimum size of nameplates is 1 by 2.5 inches. Lettering is a minimum of 0.25 inch high normal block style.

### 3.2.9 Identification Plates And Warnings

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Attach identification plates to process control devices and pilot lights.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. For circuits 480 volts and above, install conspicuously located warning signs in accordance with OSHA requirements.

### 3.2.10 Posted Operating Instructions

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Ensure operating instructions do not fade when exposed to sunlight. Secure instructions to prevent easy removal or peeling.

Ensure each system and principal item of equipment is as specified in the technical sections for use by operation and maintenance personnel. Include the following information with the operating instructions:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.

- e. Other items of instruction as recommended by the manufacturer.

### 3.3 FIELD QUALITY CONTROL

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Use substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential is 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values is not less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to-end. Repair and re-verify any damages to existing or new electrical equipment resulting from mis-wiring. Receive approval for all repairs from the Contracting Officer prior to commencement of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance requires the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the Contracting Officer.

-- End of Section --

SECTION 26 05 48.00 10

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT  
10/07

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2011) Steel Construction Manual

ASTM INTERNATIONAL (ASTM)

ASTM E580/E580M (2014) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2013) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2008; Reprint Oct 2012) Luminaires

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below. Structural requirements shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.2.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

	Air Handling Units
Light Fixtures	


### 1.2.3 Electrical Systems

The following electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

### 1.2.4 Contractor Designed Bracing

Submit copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with UFC 3-310-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325 shall be used for the design. Develop the bracing for the following electrical equipment and systems: .

### 1.2.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size . All other interior conduit, shall be seismically protected as specified.

## 1.3 EQUIPMENT REQUIREMENTS

Submit detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail, indicating thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. Submit copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

### 1.3.1 Rigidly Mounted Equipment

The following specific items of equipment: to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Engine-Generators  
Substations

Transformers  
Switch Boards and Switch Gears  
Motor Control Centers  
Free Standing Electric Motors

#### 1.3.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished: shall be constructed and assembled to resist a horizontal lateral force of times the operating weight of the equipment at the vertical center of gravity of the equipment.

#### 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 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

Lighting Fixtures in Buildings  
Equipment Requirements

##### SD-03 Product Data

Lighting Fixtures in Buildings; G  
Equipment Requirements; G  
Contractor Designed Bracing; G

#### PART 2 PRODUCTS

##### 2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1598.

##### 2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

##### 2.3 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

#### PART 3 EXECUTION

##### 3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

### 3.2 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

#### 3.2.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of UFC 3-310-04.

#### 3.2.2 Ceiling Attached Fixtures

##### 3.2.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with ASTM E580/E580M. Seismic protection for the fixtures shall conform to the requirements of UFC 3-310-04. Recessed lighting fixtures not over 56 pounds in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

##### 3.2.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with ASTM E580/E580M. Seismic protection for the fixtures shall conform to the requirements of UFC 3-310-04.

#### 3.2.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 4 inch boxes, plaster rings, and fixture studs.

#### 3.2.4 Wall-Mounted Emergency Light Unit

Attachments for wall-mounted emergency light units shall be designed and secured for the worst expected seismic disturbance at the site.

#### 3.2.5 Lateral Force

Structural requirements for light fixture bracing shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

-- End of Section --



SECTION 26 05 71.00 40

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

02/14

PART 1 GENERAL

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

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 D877 (2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.13 (2008; INT 2009) Standard Requirements for Instrument Transformers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1 (2008) Electric Meters Code for Electricity Metering

NEMA 250 (2014) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA AB 3 (2013) Molded Case Circuit Breakers and Their Application

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 20 (2010; Reprint Feb 2012) General-Use Snap

Switches

UL 489

(2013; Reprint Mar 2014) Molded-Case  
Circuit Breakers, Molded-Case Switches,  
and Circuit-Breaker Enclosures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

SD-02 Shop Drawings

Protective Devices

SD-03 Product Data

Enclosures

Circuit Breakers

Time Switches

SD-06 Test Reports

SD-07 Certificates

SD-08 Manufacturer's Instructions

Protective Devices

SD-10 Operation and Maintenance Data

Circuit Breakers

Time Switches

## PART 2 PRODUCTS

### 2.1 SYSTEM DESIGN

Submit Connection Diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Fabrication Drawings for control devices and protective devices consisting of fabrication and assembly details performed in the factory.

### 2.2 ENCLOSURES

#### 2.2.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed inside, clean, dry locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

Contain equipment installed in wet locations in a NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure. Construct enclosure to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

### 2.3 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, and NEMA AB 3.

#### 2.3.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 amperes and that conform to NEMA AB 3.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the

circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

For circuit breakers used for meter circuit disconnects, meet the applicable requirements of NFPA 70 and are the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

### 2.3.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and UL 489.

Provide enclosed circuit breakers in non-hazardous locations as follows:

- a. Contain circuit breakers installed inside clean, dry locations in NEMA Type 1, general purpose sheet steel enclosures.
- b. Contain circuit breakers installed in unprotected outdoor locations, in NEMA Type 3R, weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.
- c. Contain circuit breakers installed in wet locations, in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to prevent entrance of water.

### 2.4 TIME SWITCHES

Provide time switches for the control of tungsten-lamp loads, fluorescent-lamp loads, resistive-heating loads, motors, and magnetically operated devices, consisting of a motor-driven time dial and switch assembly in a NEMA 250, Type 1 general-purpose enclosure.

Provide motor drives consisting of 120-volt, single-phase, 60-hertz, heavy-duty, self-starting synchronous motors, directly connected to the time dial through a geartrain operating mechanism. Provide a spring-wound stored-energy source of reserve power that automatically operates the mechanism for a period of not less than 12 hours in case of electric power failure. Ensure spring automatically rewinds electrically in not more than 3 hours of time after electric power is restored.

Include a heavy-duty general-purpose precision snap-action switch in accordance with UL 20 for switch mechanism, with provision for a manual "OFF" and "ON" operation of the switch.

Provide time switches for the control of 120/240-volt, 2- and 3-wire, single-phase, 60-hertz circuits and 120/208-volt, three-phase, 4-wire, 60-hertz circuits, with a continuous-current tungsten-lamp load rating of 35 amperes.

Provide astronomic type time dials which automatically change settings each day, in accordance with the seasonal time changes in sunrise and sunset.

Provide astronomic type dials that have adjustable on and off trippers, for repetitive switching operations at solar time each day and each day in the year and that make one revolution in a 24-hour period of time. Provide time dials that are designed to operate in the "ON" position at sunset and be fully adjustable upward in 15-minute intervals of time throughout each day, and that indicate the day and month of the year. Calibrate dial in 15-minute intervals over a 24-hour period of time around its circumference. Make provision to defeat the switching operation over weekends or up to 6 preselected calendar days each week.

## 2.5 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of NEMA ICS 1.

## 2.6 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS.

## 2.7 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install Control devices and protective devices that are not factory installed in equipment, in accordance with the manufacturer's recommendations. Field adjust and operations test the control and protective devices. Conform to NFPA 70, NEMA ICS 1 and NEMA ICS 2 requirements for installation of control and protective devices.

## 3.2 FIELD TESTING

Demonstrate the operation and controls of protective devices of non-factory installed equipment.

Verify tap settings of instrumentation, potential, and current transformers.

Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D877, and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to ANSI C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has

been approved by the Contracting Officer. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words Final Test Reports to the Contracting Officer for approval.

-- End of Section --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

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.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS (2013) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections; G

SD-07 Certificates

Qualifications of organization, and lead engineering technician; G

Acceptance test and inspections procedure; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

- a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials,

devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

- b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

#### 1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

#### 1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

### PART 2 PRODUCTS

Not used.

### PART 3 EXECUTION

#### 3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

#### 3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion



of acceptance tests and inspections.

### 3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 26 09 23.00 40

LIGHTING CONTROL DEVICES

08/13

PART 1 GENERAL

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.1 REFERENCES

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

GREEN SEAL (GS)

GS-12 (1997) Occupancy Sensors

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

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15 Radio Frequency Devices (47 CFR 15)

UNDERWRITERS LABORATORIES (UL)

UL 98 (2004; Reprint Oct 2014) 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. 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

Time Switch

Occupancy Sensors

SD-06 Test Reports

System Operation Tests

SD-10 Operation and Maintenance Data

1.3 MAINTENANCE MATERIAL SUBMITTALS

Submit operation and maintenance data, lighting control system, data package 5, in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. Show information for all lighting fixtures, control modules, control zones, occupancy sensors, motion sensors, light level sensors, power packs, dimming ballasts, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.2 COMPONENTS

2.2.1 Time Control Switches

Install switches with not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

2.2.2 Manual and Safety Switches

Provide Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at a pre-determined time between 2030 hours and 0230 hours or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide a switch rated at 120/277 volts, having automatically wound spring mechanism to maintain accurate time for a minimum of 7 hours following a power failure, with a time switch with a manual on-off bypass switch. Provide surface mounted housing for the time switch, type NEMA 1 (indoor) enclosure conforming to NEMA ICS 6.

Provide a switch mechanism consisting of a heavy-duty general-purpose precision snap-acting switch, with NEMA ICS 6 Type 1 enclosures,, single-pole, single-throw, with a minimum rating of 1,000-watts incandescent-lamp load and 1,200-volt-amperes reactive for vapor-lamp load at rated voltage and frequency. Provide with a selector switch having a minimum of three positions: ON, OFF, and AUTOMATIC. Use the automatic position when photoelectric or timer system control is desired. Interface the selector switch with the lighting system magnetic contactor to control system activity.

Ensure switches conform to UL 98. Provide a quick-make, quick-break type switch such that a screwdriver is required to open the switch door when the switch is on, with blades visible when the door is open. Coordinate terminal lugs with the wire size.

### 2.2.3 Lighting Contactor

Provide NEMA ICS 2, electrically held contactor, Rate contactor as indicated. Provide in a NEMA 4 enclosure conforming to NEMA ICS 6. Provide contactors with silver alloy double-break contacts requiring no arcing contacts. Provide contactor with hand-off-automatic selector switch.

### 2.2.4 Time Switch

Provide astronomic dial type or electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide a 120/277 volts rated switch, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Surface mount the housing for the time switch, inside a NEMA 3R enclosure conforming to NEMA ICS 6.

### 2.2.5 Occupancy Sensors

Provide UL listed occupancy sensor complying with FCC Part 15 and GS-12. Design occupancy sensors and power packs to operate on the voltage indicated. Provide sensors and power packs with circuitry that only allows load switching at or near zero current crossing of supply voltage, with mounting as indicated. Provide sensor with an LED occupant detection indicator, adjustable sensitivity, and adjustable delayed-off time range of 5 minutes to 15 minutes. Provide color matching the adjacent wall plates wall mounted sensors, and white ceiling mounted sensors. Provide ceiling mounted sensors with 360 degree coverage unless otherwise indicated.

Provide sensors with:

#### c. Ultrasonic/Infrared Combination Sensor

- (1) Occupancy detection to turn lights on requires both ultrasonic and infrared sensor detection, such that the lights remain on if either the ultrasonic or infrared sensor detects movement. Provide infrared sensor with a lens selected for indicated usage and daylight filter to prevent short wavelength infrared interference. Provide crystal controlled ultrasonic sensor frequency.

### 2.2.6 Equipment Identification

#### 2.2.6.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in an inconspicuous place; the nameplate of the distributing agent is not acceptable.

#### 2.2.6.2 Labels

Provide labeled control devices, clearly marked for operation of specific lighting functions according to type. Note the following devices characteristics in the format "Use Only \_\_\_\_\_":

Ensure markings related to control device type are clear. Locate markings

where readily visible to service personnel, but unseen from normal viewing angles when devices are in place.

### 2.3 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Submit installation drawings for occupancy sensitive control devices in accordance with the manufacturer's recommended instructions for installation.

#### 3.1.1 Time Control Switches

Install switches with not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

#### 3.1.2 Manual and Safety Switches

Coordinate terminal lugs with the wire size. Securely fasten switches to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

#### 3.1.3 Magnetic Contactors

Install magnetic contactors mechanically held, electrically operated, conforming to NEMA ICS 1 and NEMA ICS 2, suitable for 120 volts, single phase, 60 Hz, with coil voltage of 120 volts. Provide contactors with maximum continuous ampere rating and number of poles as indicated on drawings. Provide enclosures for contactors mounted indoors conforming to NEMA ICS 6, Type 1. Provide each contactor with a spare, normally open auxiliary contact.

Coordinate terminal lugs with the wire size. Securely fasten switches to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

### 3.2 FIELD QUALITY CONTROL

Perform system operation tests in accordance with referenced standards in this section.

Demonstrate that photoconductive control devices operate satisfactorily in the presence of the Contracting Officer.

-- 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                     |

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   | (2014) 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 6 | (1993; R 2011) Enclosures  |
| NEMA KS 1  | (2013) Enclosed and Miscellaneous  |

Distribution Equipment Switches (600 V  
Maximum)

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 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; ERTA 1 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	(2015d) 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 1242	(2006; Reprint Mar 2014) Standard for Electrical Intermediate Metal Conduit -- Steel
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 2043	(2013) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
UL 360	(2013; Reprint Jan 2015) Liquid-Tight Flexible Steel Conduit
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 5	(2011) Surface Metal Raceways and Fittings
UL 50	(2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
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; Reprint Dec 2014) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers



UL 5A	(2003; Reprint Jun 2013) Nonmetallic Surface Raceways and Fittings
UL 6	(2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 651	(2011; Reprint May 2014) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 67	(2009; Reprint Apr 2015) Standard for Panelboards
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 869A	(2006) Reference Standard for Service Equipment
UL 870	(2008; Reprint Feb 2013) Standard for Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	(2006; Reprint Jun 2012) Ground-Fault Circuit-Interrupters

## 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 Contractor Quality Control approval. 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.

### SD-02 Shop Drawings

#### Panelboards; G

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. 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.

Wireways; G

SD-03 Product Data

Receptacles; G

Circuit breakers; G

Switches; G

Enclosed circuit breakers; G

Include performance and characteristic curves.

SD-06 Test Reports

SD-07 Certificates

SD-09 Manufacturer's Field Reports

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" 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.

1.4.3 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 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.

#### 1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

#### 1.4.3.2 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.

#### 1.7 SEISMIC REQUIREMENTS

Provide seismic details conforming to Section 13 48 00, SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and to Section 26 05 48.00 10, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

## 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, and EPC-80 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

Die Cast compression type.

### 2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit

UL 1660.

2.3 SURFACE RACEWAY

2.3.1 Surface Metal Raceway

UL 5, two-piece painted steel, totally enclosed, snap-cover type.

2.3.2 Surface Nonmetallic Raceway

UL 5A, nonmetallic totally enclosed, snap-cover type.

2.4 CABLE TRAYS

NEMA VE 1.

2.4.1 Basket-Type Cable Trays

2.4.2 Trough-Type Cable Trays

2.4.3 Ladder-Type Cable Trays

2.4.4 Channel-Type Cable Trays

2.4.5 Solid Bottom-Type Cable Trays

2.4.6 Cantilever

2.5 OPEN TELECOMMUNICATIONS CABLE SUPPORT

2.5.1 Open Top Cable Supports

Provide open top cable supports in accordance with UL 2043. Provide galvanized steel open top cable supports.

2.5.2 Closed Ring Cable Supports

2.6 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.6.1 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.
- d. Outlet boxes for fiber optic telecommunication outlets: include a minimum 3/8 inch deep single or two gang plaster ring as shown and installed using a minimum 1 inch conduit system.

## 2.7 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

## 2.8 WIRES AND CABLES

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.

### 2.8.1 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.

2.8.1.1 Equipment Manufacturer Requirements  
When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

### 2.8.1.2 Minimum Conductor Sizes

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.

## 2.8.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

### 2.8.2.1 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.

### 2.8.2.2 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
- c. 120/240 volt, single phase: Black and red

## 2.8.3 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.

## 2.8.4 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.

### 2.8.4.1 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. Provide insulated TBB with insulation as specified in the paragraph INSULATION and meeting the fire ratings of its pathway.

#### 2.8.4.2 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.

#### 2.8.5 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

### 2.9 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.

### 2.10 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.
- c. For nonmetallic boxes and fittings, other suitable plates may be provided.
- d. Plates on finished walls: nylon or lexan, minimum 0.03 inch wall thickness and same color as receptacle or toggle switch with which they are mounted.
- f. Screws: machine-type with countersunk heads in color to match finish of plate.
- g. Sectional type device plates are not be permitted.
- h. Plates installed in wet locations: gasketed and UL listed for "wet locations."

### 2.11 SWITCHES

#### 2.11.1 Toggle Switches

NEMA WD 1, UL 20, single pole, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

- a. Handles: white 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.

#### 2.11.2 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

#### 2.11.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. 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.

#### 2.12 RECEPTACLES

Provide the following:

- a. UL 498, hard use (also designated heavy-duty), grounding-type.
- b. Ratings and configurations: as indicated.
- c. Bodies: white 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.

##### 2.12.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle: switched when installed.

##### 2.12.2 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.

##### 2.12.3 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.

## 2.13 PANELBOARDS

Provide panelboards in accordance with the following:

- a. UL 67 and UL 50 having a short-circuit current rating as indicated.
- b. Panelboards for use as service disconnecting means: 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. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings.
- f. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise.
- g. Main breaker: "separately" mounted "above" or "below" branch breakers.
- h. Where "space only" is indicated, make provisions for future installation of breakers.
- i. Directories: indicate load served by each circuit in panelboard.
- j. Directories: indicate source of service to panelboard (e.g., Panel PA served from Panel MDP).
- k. Provide new directories for existing panels modified by this project as indicated.
- l. Type directories and mount in holder behind transparent protective covering.
- m. Panelboards: listed and labeled for their intended use.
- n. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

### 2.13.1 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.

#### 2.13.2 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.

#### 2.13.3 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.

##### 2.13.3.1 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.

##### 2.13.3.2 Circuit Breaker With Ground-Fault Circuit Interrupter

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A ground-fault circuit interrupter.

##### 2.13.3.3 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.

#### 2.14 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated.

#### 2.15 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.

#### 2.16 TELECOMMUNICATIONS SYSTEM

Provide system of telecommunications wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires, wireways, and other accessories for telecommunications outlets and pathway in accordance with TIA-569 and as specified herein. Additional telecommunications requirements are specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

#### 2.17 GROUNDING AND BONDING EQUIPMENT

##### 2.17.1 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.

##### 2.17.2 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.

#### 2.18 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.

## 2.19 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.
- f. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.
- g. Minimum size of nameplates: one by 2.5 inches.
- h. Lettering size and style: a minimum of 0.25 inch high normal block style.

## 2.20 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.

## 2.21 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, FIRESTOPPING .

## 2.22 WIREWAYS

UL 870. Material: steel galvanized 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with screw-cover NEMA 1or 3R enclosure per NEMA ICS 6.

## 2.23 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.

## 2.24 SOURCE QUALITY CONTROL

### 2.24.1 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.

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## 2.25 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

## 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 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 in accordance with Section 07 84 00, FIRESTOPPING.

##### 3.1.1.1 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.

### 3.1.1.2 Metal Clad Cable

Install in accordance with NFPA 70, Type MC cable.

### 3.1.2 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.

#### 3.1.2.1 Restrictions Applicable to Aluminum Conduit

- a. Do not install underground or encase in concrete or masonry.
- b. Do not use brass or bronze fittings.
- c. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

#### 3.1.2.2 Restrictions Applicable to EMT

- a. Do not install underground.
- b. Do not encase in concrete, mortar, grout, or other cementitious materials.
- c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.
- d. Do not use in hazardous areas.
- e. Do not use outdoors.
- f. Do not use in fire pump rooms.
- g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

#### 3.1.2.3 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).

#### 3.1.2.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

#### 3.1.2.5 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40  
Plastic coating: extend minimum 6 inches above floor.

#### 3.1.2.6 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 installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

#### 3.1.2.7 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.

#### 3.1.2.8 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.

### 3.1.2.9 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 for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

### 3.1.2.10 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, and wireways in accordance with TIA-569.
- 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 and wireways for telecommunications risers in accordance with TIA-569.

### [ ] 3.1.3 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.

### ] 3.1.4 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, and when specifically indicated. Boxes in other locations: sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic 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 fixtures for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

#### 3.1.4.1 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.

#### 3.1.4.2 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.

#### 3.1.4.3 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.

#### 3.1.5 Mounting Heights

Mount panelboards, circuit breakers, 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. Wall-mounted telecommunications outlets: mounted at height indicated. Mount other devices as indicated.

#### 3.1.6 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 Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS. and manufacturer's recommendations Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING

TELECOMMUNICATIONS CABLING SYSTEMS.

3.1.6.1 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.

3.1.7 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.

3.1.8 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.

3.1.9 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.10 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, 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.

#### 3.1.10.1 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, may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

#### 3.1.10.2 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.

#### 3.1.10.3 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.

#### 3.1.10.4 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.

### 3.1.10.5 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 exceeds 3 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 TGB or 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.

### 3.1.11 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.

### 3.1.12 Government-Furnished Equipment

Contractor rough-in for Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

### 3.1.13 Repair of Existing Work

Perform repair of existing work, demolition, and modification of existing electrical distribution systems as follows:

#### 3.1.13.1 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.

#### 3.1.13.2 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.

#### 3.1.13.3 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, as indicated.

#### 3.1.13.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Maintain existing circuits of equipment energized. Restore circuits wiring and power which are to remain but were disturbed during demolition back to original condition.

### 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. Painting: as specified in Section 09 90 00 PAINTS AND COATINGS.

### 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 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.

### 3.5.4 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 24 16.00 40

PANELBOARDS

08/13

PART 1 GENERAL

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.1 REFERENCES

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2014) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

NEMA PB 1 (2011) Panelboards

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595 (Rev C; Notice 1) Colors Used in  
Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 489 (2013; Reprint Mar 2014) Molded-Case  
Circuit Breakers, Molded-Case Switches,  
and Circuit-Breaker Enclosures

UL 67 (2009; Reprint Apr 2015) Standard for  
Panelboards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Outline Drawings

SD-03 Product Data

Panelboards

Directory Card and Holder



SD-06 Test Reports

SD-07 Certificates

Statements

SD-08 Manufacturer's Instructions

Panelboards

### 1.3 MAINTENANCE MATERIAL SUBMITTALS

Submit manufacturer's instructions for panelboards including special provisions required to install equipment components and system packages. Special notices detail impedances, hazards and safety precautions.

### 1.4 QUALITY ASSURANCE

Ensure the manufacturer of the assembly is the manufacturer of the major components within the assembly and has produced similar electrical equipment for a minimum period of five years.

Provide statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Ensure statements are dated after the award of this contract, with the project name, and a list of the specific requirements which it is intended to address.

## PART 2 PRODUCTS

### 2.1 COMPONENTS

#### 2.1.1 Panelboards

Submit detail drawings for the panelboards consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents. Include within drawings details of bus layout.

Ensure outline drawings for panelboards indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Totally enclose power-distribution panelboards and lighting and appliance branch-circuit panelboards in a steel cabinet, dead-front circuit breaker type with copper buses, surface- or flush-mounted as indicated. Ensure panelboards conform to NEMA PB 1 and UL 489. Provide branch circuit panels with buses fabricated for bolt-on type circuit breakers.

Provide an outer door or cover, hinged on one side, on surface-mounted panelboards to provide gutter space access. Provide a center door for circuit breaker/switch access only.

Voltage and current rating, number of phases, and number of wires is as indicated. Provide four-wire distribution panelboards and lighting and appliance branch-circuit panelboards with an isolated full-capacity neutral

bus. Ensure panelboards are rated for 120/208-volt, three-phase 277/480-volt, three-phase, 60-hertz current.

Provide three-phase, 4-wire and single-phase, 3-wire distribution lighting and branch circuit panelboards with an isolated full-capacity bus providing spaces for single-pole circuit breakers/switches and spaces indicated as spare.

Provide panelboards with a separate grounding bus bonded to the enclosure. Ensure grounding bus is a solid bus bar of rectangular cross section equipped with binding screws for the connection of equipment grounding conductors.

Ensure each panelboard, as a complete unit, has a short-circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or as indicated.

Ensure panelboards and main lugs or main breaker have current ratings as shown on the panelboard schedule.

Bus bar connections to the branch circuit breakers are the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard busing is such that when any two adjacent single-pole breakers are connected to opposite phases, two-pole breakers can be installed in any location. Three-phase, four-wire busing is such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two- or three-pole breakers can be installed at any location. Ensure current-carrying parts of the bus assembly are plated. Mains ratings are as shown.

For mechanical lugs furnished with panelboards, use cast copper or copper alloys of sizes suitable for the conductors indicated.

Use boxes with the manufacturer's standard knockouts and are galvanized code-gage sheet steel. Fronts are of code-gage sheet steel furnished with hinged doors with adjustable trim clamps for securing the fronts to the boxes.

Ensure panelboard enclosures are NEMA 250, Type 1. Provide enclosures with hinged fronts and corrosion-resistant steel pin-tumbler cylinder locks.

Key the locks alike and properly tagged. Provide two keys for each enclosure to the Contracting Officer.

Finish panelboards with baked enamel. Finish color is No. 61 gray conforming to FED-STD-595.

#### 2.1.2 Circuit Breakers

Provide molded-case breakers as specified in Section 26 05 71.00 40 LOW VOLTAGE OVERCORRECT PROTECTIVE DEVICES. Frame and trip ratings are as indicated.

Interrupting rating of circuit breakers are as indicated. If not shown, the interrupting rating for circuit breakers in 120/208-volt panelboards is not less than 10,000 amperes rms symmetrical, and that for breakers in 277/480-volt panelboards is not less than 14,000 amperes rms symmetrical.

Use bolt-on type breakers. Plug-in type is not acceptable.

Provide shunt trips where indicated.

In branch circuit panelboards, ensure branch circuit breakers feeding convenience outlets have sensitive instantaneous trip settings of not more than 10 times the trip rating of the breaker to prevent repeated arcing shorts resulting from frayed appliance cords. Provide UL listed single-pole 15- and 20-ampere circuit breakers as "Switching Breakers" at 120 volts ac. Provide UL Class A (5-milliampere sensitivity) ground fault circuit protection on 120-volt ac branch circuit as indicated. This protection is an integral part of the branch circuit breaker that also provides overload and short-circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption is not to disturb the feeder circuit to the panelboard. A single-pole circuit breaker with integral ground fault circuit interruption requires no more panelboard branch circuit space than a conventional slide pole circuit breaker.

Ensure connections to the bus are bolt-on type.

When multiple wires per phase are specified, furnish the circuit breakers with connectors made to accommodate multiple wires.

Ensure circuit breaker spaces called out on the drawings are complete with mounting hardware to permit ready installation of the circuit breakers.

#### 2.1.3 Directory Card and Holder

Mount a directory card on the inside of hinged fronts and doors under 0.030-inch thick minimum plastic in a metal frame, with spaces for circuit numbers, outlets controlled, and room numbers. Where hinged fronts or doors are not required, provide the directory card under 0.030-inch thick minimum plastic in a metal frame mounted on the left-hand side of the front trim. The directory card identifies each branch circuit with its respective and numbered circuit breaker.

#### 2.1.4 Precautionary Label

To ensure persons are aware of immediate or potential hazard in the application, installation, use, or maintenance of panelboards, conspicuously mark each panelboard on the trim or dead front shield with the text (or equivalent) **DANGER** symbol. If the panel is supplied with a door, ensure the label is visible when the door is in the open position.

### 2.2 FACTORY TESTING

Test complete panelboards in accordance with UL 67.

### 2.3 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install panelboards as indicated and in accordance with the manufacturer's instructions. Fully align and mount panels so that the height of the top

operating handle does not exceed 72-inches above the finished floor.

Ensure directory-card information is typewritten in capital letters to indicate outlets controlled and final room numbers served by each circuit and is mounted in holders behind protective covering.

### 3.2 SITE TESTING

Do not energize panelboards until the recorded test data has been submitted to and approved by the Contracting Officer.

Provide test equipment, labor, and personnel as required to perform the tests as specified. Conduct continuity tests using a dc device with bell.

Demonstrate each panelboard enclosure key operates the enclosure locks in the presence of the Contracting Officer.

Conduct continuity and insulation tests on the panelboards after the installation has been completed and before the panelboard is energized.

Conduct insulation tests on 480-volt panelboards using a 1,000-volt insulation-resistance test set. Record readings every minute until three equal and consecutive readings have been obtained. Ensure resistance between phase conductors and between phase conductors and ground is not less than 50 megohms.

Conduct insulation tests on panelboards rated 300 volts or less using a 500-volt minimum insulation-resistance test set. Record readings after 1 minute and until the reading is constant for 15 seconds. Ensure resistance between phase conductors and between phase conductors and ground is not less than 25 megohms.

Record test data and include the location and identification of panelboards and megohm readings versus time.

-- 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	(2015) 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 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

GREEN SEAL (GS)

GS-12	(1997) Occupancy Sensors
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ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10	(2011) IES Lighting Handbook
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1-4 2012; INT 5-7 2013; INT 8 2014) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)
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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2015; ERTA 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

NFPA 90A (2015) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2008; Reprint Oct 2012) Luminaires

UL 924 (2006; Reprint Apr 2014) Standard for Emergency Lighting and Power Equipment

## 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. 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:

Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES HB-10, as applicable, for the lighting system specified.

SD-03 Product Data

LED lighting fixtures; G

LED electronic drivers; G

Lighting contactor; G

Time switch; G

Exit signs; G

Emergency lighting equipment; G

Occupancy sensors; G

Energy Efficiency

SD-04 Samples

Lighting fixtures, complete with lamps and drivers; G

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; G

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.

## Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

### 1.6 QUALITY ASSURANCE

#### 1.6.1 Lighting Fixtures, Complete With Lamps and Ballasts

Submit one sample of each fixture type for inspection, review, and approval. The sample shall be retained for comparison against the remainder of the fixtures. The sample may be used in the final fixture installation.

#### 1.6.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.6.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

##### 1.6.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

##### 1.6.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

##### 1.6.3.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit data indicating lumens per watt efficiency and color rendition index of light source.



## 1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

### 1.7.1 Electronic Driver Warranty

Furnish the electronic driver manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic driver. Driver assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the driver 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning driver shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement driver shall be identical to, or an improvement upon, the original design of the malfunctioning driver.

## 1.8 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement. Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

## PART 2 PRODUCTS

### 2.1 LED LIGHTING FIXTURES

UL 1598. LED fixtures shall have electronic drivers .

#### 2.1.1 Air Handling Fixtures

Fixtures used as air handling registers shall meet requirements of NFPA 90A.

### 2.2 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

### 2.3 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 to limit swinging. Single-unit suspended 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, electrically held contactor. Rate contactor as indicated. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts. Provide contactor with hand-off-automatic selector switch.

## 2.6 TIME SWITCH

Astronomic dial type or electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated 120/277 volts, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 15 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface-mounted, NEMA 1 enclosure conforming to NEMA ICS 6.

## 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, test switch, pilot light, integral self-testing module and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum). The light emitting diodes shall have rated lamp life of 70,000 hours (minimum).

## 2.8 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated.

### 2.8.1 Emergency Lighting Unit

Provide as indicated. Equip units with brown-out sensitive circuit to activate battery when ac input falls to 75 percent of normal voltage. Provide integral self-testing module.

## 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.

- 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 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.

### 2.11.3 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.

### 2.14 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

## 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 or straps per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported from the building structure by a minimum of four wires or straps per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires or straps 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 Occupancy Sensor

Provide quantity of sensor units indicated as a minimum. Provide additional units to give full coverage over controlled area. Full coverage shall provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways. Locate the sensor(s) as indicated and in accordance with the manufacturer's recommendations to maximize energy savings and to

avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage. Set sensor "on" duration to 15 minutes.

### 3.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.3 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.

#### 3.3.1 Electronic Dimming Ballast

Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range.

#### 3.3.2 Occupancy Sensor

Test sensors for proper operation. Observe for light control over entire area being covered.

-- End of Section --

SECTION 26 52 00.00 40

EMERGENCY LIGHTING

08/14

PART 1 GENERAL

1.1 REFERENCES

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2015; ERTA 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

UNDERWRITERS LABORATORIES (UL)

UL 924 (2006; Reprint Apr 2014) Standard for Emergency Lighting and Power Equipment

1.2 ADMINISTRATIVE REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.2.1 Pre-Installation Meetings

No later than 30calendar days after contract award, submit installation drawings for the Central Emergency Lighting Systems indicating location of installed fixtures.

Submit material, equipment, and fixture lists showing manufacturer's style or catalog numbers, specification and drawing reference numbers, sample warranty, and fabrication site location. Also submit manufacturer's catalog data and certificates of conformance for the following items:

- a. Emergency Lighting Egress Units
- b. Emergency Fluorescent Lighting
- c. Central Emergency Lighting Systems
- d. Accessories

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. 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

SD-03 Product Data

Material, Equipment, and Fixture Lists

Sample Warranty

Emergency Lighting Egress Units

SD-06 Test Reports

System Operational Tests

SD-07 Certificates

Certificates of Conformance

SD-11 Closeout Submittals

Warranty

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Furnish emergency lighting units completely assembled with wiring and mounting devices, ready for installation at the locations indicated. Equip fixtures with lamps. Ensure emergency lighting units are suitable for operation on the ac supply circuit to which they are to be electrically connected.

2.1.1 Performance Requirements

Provide emergency lighting units conforming to UL 924 and NFPA 101.

2.2 MANUFACTURED UNITS

2.2.1 Emergency Lighting Egress Units

Provide complete self-contained emergency lighting units with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, indicator lights, on/off switch, and test switch, in accordance with UL 924 for Type I (emergency light set), Class I rechargeable storage-battery-powered unit, Style D , as indicated.

2.2.1.1 Batteries

Provide batteries rated not less than 6-12 volts. Provide batteries with the capacity and rating to supply the lamp load with maintained 87.5 percent power, minimum, for 1.5 hours, or the battery-lamp combination



maintaining 60-percent, minimum, illumination. Provide maintenance-free nickel-cadmium type batteries, with a minimum normal life of 10 years.

#### 2.2.1.2 Battery Charger

Include in battery charger a dry-type full-wave rectifier with two charging rates, one to automatically maintain the battery in a fully charged state under normal conditions and the other to automatically recharge the battery to a fully charged state within 12 hours after continuous discharge of 1-1/2 hours through the connected lampload.

#### 2.2.1.3 Unit Enclosure

Fabricate the unit enclosure from sheet steel not less than 18-gage. Design of cover is to provide access to the battery and battery-charger compartments and have a full-length piano hinge and a latching device. Protect component parts within the enclosure from dust, moisture, and oxidizing fumes from the battery. Coat interior and exterior surfaces of enclosure with a corrosion-resistant gray baked-enamel finish.

#### 2.2.1.4 Lampheads, Lamps, and Indicating Lights

Mount the lampheads on the top of the unit enclosure, or wall mount, except where otherwise indicated and fully adjustable in the horizontal and vertical planes. Provide steel lamp head assembly with nickel plating. Form the exterior housing of the lamp from nickel-plated sheet steel.

Provide sealed-beam type lamps, halogen, rated not less than 12 watts at the specified dc voltage.

Mount an amber "ready-for-use on alternating current" indicating light, a red "recharging on alternating current" indicating light, and a momentary-contact pushbutton test switch on the cover of the unit enclosure. The amber light indicates, when illuminated, that the unit is electrically connected to the normal ac supply source and that the battery is fully charged. The red light indicates, when illuminated, that the battery is being recharged. The momentary-contact pushbutton test switch transfers the unit from normal supply to battery supply and tests operation of equipment under simulated ac source power failure.

#### 2.2.1.5 Relays and Switches

Provide an under-voltage relay of the self-clearing type which automatically connects the lampload to the battery supply upon failure of the alternating current supply. Mount an on-off toggle switch inside the unit enclosure to disconnect the battery from the lampload when the unit is taken out of service for maintenance purposes. The relay energizes when the ac supply falls to 70 percent of normal voltage.

#### 2.2.2 Self-Testing Module

Provide self-testing module for exit signs and emergency lighting equipment which performs 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. Conduct the battery capacity test using a synthetic load.

- c. Manual test switch to simulate a discharge test cycle.
- d. Provide module with low voltage battery disconnect (LVD) and brown-out protection circuit.

### 2.3 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Permanently fix in place the emergency lighting unit and install wiring for each unit in accordance with NFPA 70. Use the same panel bus or branch circuit as that serving the normal lighting in the area for the branch circuit feeding the unit equipment, and connect ahead of area switches. Keep remotely connected emergency lighting circuit wiring independent of all other wiring and equipment and do not enter the same conduit, cable, box, or cabinet with other wiring unless the fixture is supplied from two sources.

Mount emergency lighting units and remote lamps at a minimum of 7-feet above the finished floor.

### 3.2 FIELD QUALITY CONTROL

Demonstrate emergency lighting units to operate satisfactorily in the presence of the Contracting Officer.

Perform and submit System Operational Tests in accordance with referenced standards in this section.

### 3.3 WARRANTY

Submit 6 copies of ]warranty, signed by an authorized representative, designating the Government as warrantee, to the Contracting Officer, 5 days prior to project closeout.

-- End of Section --

SECTION 26 53 00.00 40

EXIT SIGNS  
11/08

PART 1 GENERAL

1.1 REFERENCES

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2015; ERTA 2015) Life Safety Code

U.S. DEPARTMENT OF ENERGY (DOE)

DOE LT-4 (2000) How to Buy Energy-Efficient Exit Signs

UNDERWRITERS LABORATORIES (UL)

UL 924 (2006; Reprint Apr 2014) Standard for Emergency Lighting and Power Equipment

1.2 ADMINISTRATIVE REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.2.1 Pre-Installation Meetings

No more than 30 days after Contract Award, the Contracting Officer will schedule a Pre-Installation Meeting. Submit Material, Equipment, and Fixture Lists for the following showing manufacturer's product data, including style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site:

- a. Exit Lighting Units
- b. Contemporary Fixtures
- c. Accessories
- d. Exit Lighting Units Outline Drawings indicating overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Also submit certificates clearly indicating the energy efficiencies of each fixture type and conformance with 42 U.S.C. 8253(f) "Use of Energy and Water Efficiency in Federal Buildings, September 2012", and DOE's Facility Energy Management Guidelines and Criteria for Energy and Water Evaluations in Covered Facilities,  
[http://www1.eere.energy.gov/femp/technologies/procuring\\_eeproducts.html](http://www1.eere.energy.gov/femp/technologies/procuring_eeproducts.html)

### 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. 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-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists

#### SD-02 Shop Drawings

Exit Lighting Units

Exit Lighting Units Outline Drawings

#### SD-03 Product Data

Exit Lighting Units

#### SD-06 Test Reports

Operational Tests

#### SD-07 Certificates

Energy Efficiencies

## PART 2 PRODUCTS

### 2.1 PRODUCT STANDARDS

Provide emergency exit lighting fixtures conforming to UL 924, NFPA 101, and as specified.

Provide exit lighting fixtures completely assembled with wiring and mounting devices, ready for installation at the locations indicated. Ensure ceiling-mounted fixtures are designed to be supported independent of the ceiling and equipped with lamps.

#### 2.1.1 Energy Efficiencies

Provide exit lighting fixtures having efficiencies in accordance with the recommended levels specified in DOE LT-4.

### 2.2 EMERGENCY POWER LOSS EXIT LIGHTING UNITS

Provide each self-contained unit with an automatic power failure device, test switch, pilot light, and fully automatic high/low solid-state trickle charger in a self-contained power pack. Provide with gelled-electrolyte type battery, maintenance-free for a period of not less than 10-years under normal operating conditions. Ensure normal operation is with 120/277 -volts.

[2.3 LIGHT EMITTING DIODES (LEDs) EXIT LIGHTING FIXTURES

Provide single or double faced exit lighting fixtures as shown with sheet metal enclosures, including frames, battery charger, batteries, red light emitting diodes (LEDs), and mounting brackets with mounting plates suitable for securing the fixture to a 4 inch outlet box. Ensure fixture features include:

- a. continuous charging
- b. automatic switching to standby batteries upon loss of power
- c. overload protection
- d. short circuit protection
- e. test switch
- f. low voltage disconnect
- g. switch controlled left and right LED directional arrows
- h. field connectable to operate from 115 volts
- i. brightness not less than ten (10) candlepower

Provide unit battery system with minimum operating time of three (3) hours for double faced fixtures and seven (7) hours for single faced fixtures.

Provide a five year warranty for all components.

][[

2.4 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

PART 3 EXECUTION

3.1 INSTALLATION

Connect fixtures to the main panel bus through overcurrent protection. Use emergency lighting panel where available.

3.2 FIELD TESTING

Field test exit lighting to demonstrate satisfactory operation in the presence of the Contracting Officer.

Perform and submit Operational Tests in accordance with referenced standards in this section.

-- End of Section --

SECTION 26 56 00

EXTERIOR LIGHTING

05/13

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 in the text by the basic designation only.

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

ASHRAE 189.1 (2014; Errata 1-2 2015;) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM B117 (2011) Standard Practice for Operating Salt Spray (Fog) Apparatus

ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10 (2011) IES Lighting Handbook

IES LM-79 (2008) Electrical and Photometric Measurements of Solid-State Lighting Products

IES LM-80 (2008) Measuring Lumen Maintenance of LED Light Sources

IES RP-16 (2010; Addendum A 2008; Addenda B & C 2009) Nomenclature and Definitions for Illuminating Engineering

IES RP-8 (2014) Roadway Lighting

IES TM-15 (2011) Luminaire Classification System for Outdoor Luminaires

IES TM-21 (2011) Projecting Long Term Lumen Maintenance of LED Light Sources

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 C62.41.2 (2002) Recommended Practice on

Characterization of Surges in Low-Voltage  
(1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.377	(2011) American National Standard for Electric Lamps- Specifications for the Chromaticity of Solid State Lighting Products
NEMA C136.31	(2010) American National for Roadway and Area Lighting Equipment - Luminaire Vibration
NEMA C82.77	(2002) Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment
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

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

47 CFR 15	Radio Frequency Devices
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UNDERWRITERS LABORATORIES (UL)

UL 1310	(2011; Reprint Dec 2014) UL Standard for Safety Class 2 Power Units
UL 1598	(2008; Reprint Oct 2012) Luminaires
UL 8750	(2009; Reprint May 2014) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.2 RELATED REQUIREMENTS

Luminaires and accessories installed in interior of buildings are specified in Section 26 51 00 INTERIOR LIGHTING.

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 and IES RP-16.

- c. For LED luminaire light sources, "Useful Life" is the operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70 percent "Rated Lumen Maintenance Life" as defined in IES LM-80.

#### 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 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

##### SD-01 Preconstruction Submittals

LED Luminaire Warranty; G

##### SD-02 Shop Drawings

Luminaire drawings; G

##### SD-03 Product Data

LED Luminaires; G

Luminaire Light Sources; G

Luminaire Power Supply Units (Drivers); G

Lighting contactor; G

Time switch; G

Motion Sensor; G

##### SD-04 Samples

LED Luminaires; G

Submit one sample of each luminaire type, complete with light source and ballast, generator or power supply unit. Sample will be returned to the Contractor for installation in the project work.



SD-05 Design Data

Design Data for luminaires; G

SD-06 Test Reports

LED Luminaire - IES LM-79 Test Report; G

LED Light Source - IES LM-80 Test Report; G

Operating test

Submit operating test results as stated in paragraph entitled "Field Quality Control."

SD-07 Certificates

Luminaire Useful Life Certificate; G

Submit certification from the manufacturer indicating the expected useful life of the luminaires provided. The useful life shall be directly correlated from the IES LM-80 test data using procedures outlined in IES TM-21. Thermal properties of the specific luminaire and local ambient operating temperature and conditions shall be taken into consideration.

SD-08 Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Electronic Driver Warranty

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details.

1.5.2 Design Data for Luminaires

- a. Provide distribution data according to IES classification type as defined in IES HB-10.
- b. Shielding as defined by IES RP-8 or B.U.G. rating for the installed position as defined by IES TM-15.

- c. Provide safety certification and file number for the luminaire family. Include listing, labeling and identification per NFPA 70 (NEC). Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratories).
- d. Provide long term lumen maintenance projections for each LED luminaire in accordance with IES TM-21. Data used for projections shall be obtained from testing in accordance with IES LM-80.
- e. Provide wind loading calculations for luminaires mounted on poles. Weight and effective projected area (EPA) of luminaires and mounting brackets shall not exceed maximum rating of pole as installed in particular wind zone area.

#### 1.5.3 LED Luminaire - IES LM-79 Test Report

Submit test report on manufacturer's standard production model luminaire. Submittal shall include all photometric and electrical measurements, as well as all other pertinent data outlined under "14.0 Test Report" in IES LM-79.

#### 1.5.4 LED Light Source - IES LM-80 Test Report

Submit report on manufacturer's standard production LED package, array, or module. Submittal shall include:

- a. Testing agency, report number, date, type of equipment, and LED light source being tested.
- b. All data required by IES LM-80.

##### 1.5.4.1 Test Laboratories

Test laboratories for the IES LM-79 and IES LM-80 test reports shall be one of the following:

- a. National Voluntary Laboratory Accreditation Program (NVLAP) accredited for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program.
- b. One of the qualified labs listed on the Department of Energy - Energy Efficiency & Renewable Energy, Solid-State Lighting web site.
- c. A manufacturer's in-house lab that meets the following criteria:
  - 1. Manufacturer has been regularly engaged in the design and production of high intensity discharge roadway and area luminaires and the manufacturer's lab has been successfully certifying these fixtures for a minimum of 15 years.
  - 2. Annual equipment calibration including photometer calibration in accordance with National Institute of Standards and Technology.

#### 1.5.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory

provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.5.6 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

##### 1.5.6.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if the manufacturer has been regularly engaged in the design and production of high intensity discharge roadway and area luminaires for a minimum of 15 years. Products shall have been in satisfactory commercial or industrial use for 15 years prior to bid opening. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 15-year period.

##### 1.5.6.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

##### 1.6.1 LED Luminaire Warranty

Provide Luminaire Useful Life Certificate.

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.

- a. Provide a written five year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.

1. Finish warranty shall include warranty against failure and against substantial deterioration such as blistering, cracking, peeling,

chalking, or fading.

2. Material warranty shall include:

(a) All power supply units (drivers).

(b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.

b. Warranty period must begin on date of beneficial occupancy. Contractor shall provide the Contracting Officer signed warranty certificates prior to final payment.

1.7 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement. Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not deposit materials in landfills or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be luminaires, equipment or accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Luminaires and associated equipment and accessories for interior applications are specified in Section 26 51 00 INTERIOR LIGHTING.

2.2 LED LUMINAIRES

UL 1598, NEMA C82.77 and UL 8750. Provide luminaires as indicated in luminaire schedule and XL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. All luminaires of the same type shall be provided by the same manufacturer.

2.2.1 General Requirements

- a. LED luminaire housings shall be die cast or extruded aluminum.
- b. LED luminaires shall be rated for operation within an ambient temperature range of minus 22 degrees F to 122 degrees F.
- c. Luminaires shall be UL listed for wet locations per UL 1598.
- d. LED luminaires shall produce a minimum efficacy as shown in the following table, tested per IES LM-79. Theoretical models of initial raw LED lumens per watt are not acceptable.

Application	Luminaire Efficacy in Lumens per Watt

Exterior Pole/Arm-Mounted Area and Roadway Luminaires	65
Exterior Pole/Arm-Mounted Decorative Luminaires	65
Exterior Wall-Mounted Area Luminaires	60
Bollards	35
Parking Garage Luminaires	70

- e. Luminaires shall have IES distribution and NEMA field angle classifications as indicated in luminaire schedule on project plans per IES HB-10.
- f. Housing finish shall be baked-on enamel, anodized, or baked-on powder coat paint. Finish shall be capable of surviving ASTM B117 salt fog environment testing for 2500 hours minimum without blistering or peeling.
- g. Luminaires shall not exceed the following IES TM-15 Backlight, Uplight and Glare (B.U.G.) ratings:
  - 1. Maximum Backlight (B) rating shall be determined by lighting zone in which luminaire is placed.
  - 2. Maximum Uplight (U) rating shall be U0.
  - 3. Maximum Glare (G) rating shall be determined by lighting zone in which luminaire is placed.
- h. Luminaires shall be fully assembled and electrically tested prior to shipment from factory.
- i. The finish color shall be as indicated in the luminaire schedule or detail on the project plans.
- j. Luminaire arm bolts shall be 304 stainless steel or zinc-plated steel.
- k. Luminaire lenses shall be constructed of clear tempered glass or UV-resistant acrylic. Provide polycarbonate vandal-resistant lenses as indicated.
- m. Incorporate modular electrical connections, and construct luminaires to allow replacement of all or any part of the optics, heat sinks, power supply units, ballasts, surge suppressors and other electrical components using only a simple tool, such as a manual or cordless electric screwdriver.
- n. Luminaires shall have a nameplate bearing the manufacturer's name, address, model number, date of manufacture, and serial number securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.
- p. Luminaire must pass 3G vibration testing in accordance with NEMA C136.31.

- q. All factory electrical connections shall be made using crimp, locking, or latching style connectors. Twist-style wire nuts are not acceptable.

## 2.2.2 Luminaire Light Sources

### 2.2.2.1 LED Light Sources

- a. Correlated Color Temperature (CCT) shall be in accordance with NEMA ANSLG C78.377:

Nominal CCT: 4000 degrees K: 3985 plus or minus 275 degrees K

- b. Color Rendering Index (CRI) shall be:

Greater than or equal to 70 for 4000 degrees K light sources.

- c. Color Consistency:

Manufacturer shall utilize a maximum 4-step MacAdam ellipse binning tolerance for color consistency of LEDs used in luminaires.

### 2.2.3 Luminaire Power Supply Units (Drivers)

#### 2.2.3.1 LED Power Supply Units (Drivers)

UL 1310. LED Power Supply Units (Drivers) shall meet the following requirements:

- a. Minimum efficiency shall be 85 percent.
- b. Drive current to each individual LED shall not exceed 600 mA, plus or minus 10 percent.
- c. Shall be rated to operate between ambient temperatures of minus 22 degrees F and 122 degrees F.
- d. Shall be designed to operate on the voltage system to which they are connected, typically ranging from 120 V to 480 V nominal.
- e. Operating frequency shall be: 50 or 60 Hz.
- f. Power Factor (PF) shall be greater than or equal to 0.90.
- g. Total Harmonic Distortion (THD) current shall be less than or equal to 20 percent.
- h. Shall meet requirements of 47 CFR 15, Class B.
- i. Shall be RoHS-compliant.
- j. Shall be mounted integral to luminaire. Remote mounting of power supply is not allowed.
- k. Power supplies in luminaires mounted under a covered structure, such as a canopy, or where otherwise appropriate shall be UL listed with a

sound rating of A.

- m. Shall be equipped with over-temperature protection circuit that turns light source off until normal operating temperature is achieved.

#### 2.2.4 LED Luminaire Surge Protection

Provide surge protection integral to luminaire to meet C Low waveforms as defined by IEEE C62.41.2, Scenario 1, Location Category C.

### 2.3 EXTERIOR LUMINAIRE CONTROLS

Controls shall comply with Section 9 of ASHRAE 189.1.

#### 2.3.1 Timeswitch

Timeswitch shall be electromechanical type with a 24 hour astronomic dial that changes on/off settings according to seasonal variations of sunset and sunrise. Switch shall be powered by an enclosed synchronous motor with a maximum 3 watt operating rating. Timeswitch contacts shall be rated for 40 amps at 120-277 VAC resistive load in a DPST normally open (NO) configuration. Switch shall have an automatic spring mechanism to maintain accurate time for up to 16 hours during a power failure. Provide switch with function that allows automatic control to be skipped on certain selected days of the week. Provide switch with manual bypass or remote override control.

Timeswitch shall be housed in a surface-mounted, lockable NEMA 1 enclosure constructed of painted steel or plastic polymer conforming to NEMA ICS 6.

#### 2.3.2 Lighting Contactor

NEMA ICS 2. Provide a electrically-held lighting contactor housed in a NEMA 1 enclosure conforming to NEMA ICS 6. Contactor shall have 4 poles, configured as normally open (NO). Contacts shall be rated 600 volts, 30 amperes for a resistive load. Coil operating voltage shall be 120 volts. Contactor shall have silver cadmium oxide double-break contacts and shall require no arcing contacts. Provide contactor with hand-off-automatic selector switch.

### 2.4 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.

### 2.5 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.1.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test after 100 hours of burn-in time to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --



SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

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 D709 (2013) Laminated Thermosetting Materials

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

ECIA EIA/ECA 310-E (2005) Cabinets, Racks, Panels, and Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-90-661 (2012) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA/BICSI 568 (2006) Standard for Installing Building Telecommunications Cabling

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66 (2013) Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-1152 (2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

TIA-568-C.0 (2009; Add 1 2010; Add 2 2012) Generic Telecommunications Cabling for Customer Premises

TIA-568-C.1 (2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard

TIA-568-C.2 (2009; Errata 2010) Balanced Twisted-Pair Telecommunications Cabling and Components Standards

TIA-568-C.3 (2008; Add 1 2011) Optical Fiber Cabling Components Standard

TIA-569 (2015d) Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-606 (2012b) Administration Standard for the Telecommunications Infrastructure

TIA-607 (2011b) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68 Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

UNDERWRITERS LABORATORIES (UL)

UL 1286 (2008; Reprint Feb 2015) Office Furnishings

UL 1863 (2004; Reprint Nov 2012) Communication Circuit Accessories

UL 444 (2008; Reprint Apr 2015) Communications Cables

UL 467 (2007) Grounding and Bonding Equipment

UL 50 (2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations

UL 514C (2014; Reprint Dec 2014) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 723 (2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials

UL 969 (1995; Reprint Sep 2014) Standard for Marking and Labeling Systems

## 1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT (OSP), apply to this section with additions and modifications specified herein.

## 1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, TIA-606 and IEEE 100 and herein.

### 1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

### 1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

### 1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

### 1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

### 1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

### 1.3.6 Equipment Room (ER) (Telecommunications)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

### 1.3.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

### 1.3.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

### 1.3.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

## 1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the campus distributor at the center or hub of the star. Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. The telecommunications contractor must coordinate with the NMCI/COSC/NGEN contractor concerning access to and configuration of telecommunications spaces. The telecommunications contractor may be required to coordinate work effort within the telecommunications spaces with the NMCI/COSC/NGEN contractor.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Telecommunications drawings; G

Telecommunications Space Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

### SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G

Telecommunications outlet/connector assemblies; G

Equipment support frame; G

Submittals shall include the manufacturer's name, trade name,

place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G

SD-07 Certificates

Manufacturer Qualifications; G

Test plan; G

SD-09 Manufacturer's Field Reports

Factory reel tests; G

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G

SD-11 Closeout Submittals

Record Documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 11 by 17 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide registered communications distribution designer (RCDD) approved, drawings in accordance with TIA-606. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure in accordance with TIA-606. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's, BD's, and FD's to the

telecommunications work area outlets. Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, CD's, BD's, FD's, and the EF and ER for telecommunications keyed to floor plans by room number. Mount the laminated schematic in the EF telecommunications space as directed by the Contracting Officer. The following drawings shall be provided as a minimum:

- a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.
- b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID'S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.
- c. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

#### 1.6.1.2 Telecommunications Space Drawings

Provide T3 drawings in accordance with TIA-606 that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

#### 1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

##### 1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum

of five successful telecommunication system installations for the telecommunications contractor.

#### 1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

#### 1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3.

#### 1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

#### 1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

#### 1.6.5 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.

##### 1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

##### 1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

#### 1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.



## 1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

## 1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

## 1.10 MAINTENANCE

### 1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

### 1.10.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided on electronic media using Windows based computer cable management software. Provide the following T5 drawing documentation as a minimum:

- a. Cables - A record of installed cable shall be provided in accordance with TIA-606. The cable records shall include only the required data fields in accordance with TIA-606. Include manufacture date of cable with submittal.
- b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided in accordance with TIA-606. Documentation shall include the required data fields as a minimum in accordance with TIA-606.

### 1.10.3 Spare Parts

In addition to the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

## PART 2 PRODUCTS

### 2.1 COMPONENTS

Components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, 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. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

### 2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA-569 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide system furniture pathways in accordance with UL 1286.

### 2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3 and NFPA 70. Provide a labeling system for cabling as required by TIA-606 and UL 969. Ship cable on reels or in boxes bearing manufacture date for for unshielded twisted pair (UTP) in accordance with ICEA S-90-661 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

#### 2.3.1 Horizontal Cabling

Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA-568-C.1.

##### 2.3.1.1 Horizontal Copper

Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568-C.2, UL 444, ANSI/NEMA WC 66, ICEA S-90-661 . Provide four each individually twisted pair, minimum size 24 AWG conductors, Category 6, with a blue thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs shall be UL listed and labeled for wet locations in accordance with NFPA 70.

### 2.3.2 Work Area Cabling

#### 2.3.2.1 Work Area Copper

Provide work area copper cable in accordance with TIA-568-C.2, with a blue thermoplastic jacket.

### 2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility and telecommunication equipment room[s] to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA-606.

#### 2.4.1 Backboards

Provide void-free, interior grade A-C plywood 3/4 inch thick 4 by 8 feet. Backboards shall be fire rated by manufacturing process. Fire stamp shall be clearly visible. Paint applied over fire retardant backboard shall be UL 723 fire retardant paint. Provide label including paint manufacturer, date painted, UL listing and name of Installer. When painted, paint label and fire stamp shall be clearly visible. . Backboards shall be provided on a minimum of two adjacent walls in the telecommunication spaces.

#### 2.4.2 Equipment Support Frame

Provide in accordance with ECIA EIA/ECA 310-E and UL 50.

- a. Bracket, wall mounted, 8 gauge aluminum. Provide hinged bracket compatible with 19 inch panel mounting.

#### 2.4.3 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Category 6 systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

#### 2.4.4 Cable Guides

Provide cable guides specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 19 inch equipment racks and telecommunications backboards. Cable guides of ring or bracket type devices mounted on rack panels for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws, and nuts and lockwashers.

### 2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

#### 2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68, TIA-568-C.1, and TIA-568-C.2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with TIA-568-C.2 Category 6 requirements. Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be

terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired T568A or T568B as indicated. UTP outlet/connectors shall comply with TIA-568-C.2 for 200 mating cycles.

#### 2.5.2 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA-568-C.1, ; flush design constructed of high impact thermoplastic material to match color of receptacle/switch cover plates specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide labeling in accordance with the paragraph LABELING in this section.

#### 2.6 MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

Provide MUTOA(s) in accordance with TIA-568-C.1.

#### 2.7 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA-607, and NFPA 70. Components shall be identified as required by TIA-606. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

#### 2.8 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00 FIRESTOPPING.

#### 2.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 2.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

#### 2.11 TESTS, INSPECTIONS, AND VERIFICATIONS

##### 2.11.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3 cables.

#### 2.12 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with NECA/BICSI 568, TIA-568-C.1, TIA-568-C.2, TIA-569, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

##### 3.1.1 Cabling

Install UTP telecommunications cabling system as detailed in TIA-568-C.1, . Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

##### 3.1.1.1 Open Cable

Use only where specifically indicated on plans for use in cable trays, or below raised floors. Install in accordance with TIA-568-C.1, TIA-568-C.2 . Do not exceed cable pull tensions recommended by the manufacturer. Copper cable not in a wireway or pathway shall be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided.

Plenum cable shall be used where open cables are routed through plenum areas. Cable routed exposed under raised floors shall be plenum rated. Plenum cables shall comply with flammability plenum requirements of NFPA 70. Install cabling after the flooring system has been installed in raised floor areas. Cable 6 feet long shall be neatly coiled not less than 12 inches in diameter below each feed point in raised floor areas.

##### 3.1.1.2 Horizontal Cabling

Install horizontal cabling as indicated on drawings Do not untwist Category 6 UTP cables more than one half inch from the point of termination to maintain cable geometry. Provide slack cable in the form of a figure eight (not a service loop) on each end of the cable, 10 feet in the

telecommunications room, and 12 inches in the work area outlet..

### 3.1.2 Work Area Outlets

#### 3.1.2.1 Terminations

Terminate UTP cable in accordance with TIA-568-C.1, TIA-568-C.2 and wiring configuration as specified.

#### 3.1.2.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

#### 3.1.2.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 12 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

#### 3.1.2.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

### 3.1.3 Telecommunications Space Termination

Install termination hardware required for Category 6 system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

#### 3.1.3.1 Connector Blocks

Connector blocks shall be wall mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with TIA-569.

#### 3.1.3.2 Patch Panels

Patch panels shall be mounted in equipment rackson the plywood backboard with sufficient ports to accommodate the installed cable plant plus 25 percent spares.

- a. Copper Patch Panel. Copper cable entering a patch panel shall be secured to the panel with cable ties to prevent movement of the cable.

#### 3.1.3.3 Equipment Support Frames

Install in accordance with TIA-569:

- a. Bracket, wall mounted. Mount bracket to plywood backboard in accordance with manufacturer's recommendations. Mount rack so height of highest panel does not exceed 78 inches above floor.

#### 3.1.4 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

#### 3.1.5 Grounding and Bonding

Provide in accordance with TIA-607, NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

### 3.2 LABELING

#### 3.2.1 Labels

Provide labeling in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using laser printer.

#### 3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA-606.

#### 3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA-606.

### 3.3 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.

#### 3.3.1 Painting Backboards

If backboards are required to be painted, then the manufactured fire retardant backboard must be painted with fire retardant paint, so as not to increase flame spread and smoke density and must be appropriately labeled. Label and fire rating stamp must be unpainted.

### 3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

### 3.5 TESTING

#### 3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, . Test equipment shall conform to TIA-1152. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

#### 3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA-568-C.2, . Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

#### 3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but prior to being cross-connected.

#### 3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

- a. Perform Category 6 link tests in accordance with TIA-568-C.1 and TIA-568-C.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.

#### 3.5.1.4 Final Verification Tests

Perform verification tests for UTP systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

- a. Voice Tests. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.
- b. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

-- End of Section --



SECTION 32 31 13

CHAIN LINK FENCES AND GATES

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 A116	(2011) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(2013) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A90/A90M	(2013) Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM F1043	(2014) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F1083	(2013) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F567	(2014a) Standard Practice for Installation of Chain Link Fence
ASTM F626	(2014) Standard Specification for Fence Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191/3	(Rev E; Am 1) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)
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1.2 SUBMITTALS

Submit the following in accordance with contract requirements:

SD-02 Shop Drawings

Fence Assembly  
Gate Assembly  
Gate Hardware and Accessories

SD-03 Product Data

Fence Assembly  
Gate Assembly  
Gate Hardware and Accessories  
Fabric

1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Submit erection/installation drawings along with manufacturer's catalog data for complete fence assembly, gate assembly, hardware assembly and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating, thickness of PVC coating.

1.5.2 Certificates of Compliance

Submit certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following:

- a. Zinc coating
- b. PVC coating
- c. Aluminum alloy coating
- d. Fabric
- e. Stretcher bars
- f. Gate hardware and accessories
- g. Concrete

## PART 2 PRODUCTS

### 2.1 GENERAL

Provide fencing materials conforming to the requirements of ASTM A116, ASTM A702, ASTM F626, and as specified.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

### 2.2 PRODUCT SUSTAINABILITY CRITERIA

Selection of products shall apply sustainable product requirements identified in Section 01 81 13 Sustainable Design Requirements.

### 2.3 ZINC COATING

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide zinc coating conforming to the requirements of the following:

- a. Pipe: FS RR-F-191/3 Class 1 Grade A in accordance with ASTM F1083 .
- b. Hardware and accessories: ASTM A153/A153M, Table 1
- c. Surface: ASTM F1043
- d. External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.
- e. Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

### 2.4 FABRIC

Provide fabric consisting of No. 9-gage wires woven into a 2-inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A116, ASTM A702 and ASTM F626, with 2.0 ounces per square foot zinc galvanizing with PVC coating.

Provide one-piece fabric widths for fence heights with knuckle selvages.

Color of chain link fabric per ASTM F934 Black

### 2.5 TOP AND BOTTOM SELVAGES

Provide knuckled selvages at top and bottom for fabric with 2 inch mesh and up to 60 inches high, and if over 60 inches high, provide twisted and barbed top selvage and knuckled bottom selvage.

Knuckle top and bottom selvages for 1-3/4-inch and 1-inch mesh fabric.

## 2.6 LINE POSTS

Minimum acceptable line posts are as follows:

Up to 6-feet high:

Grade A: 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6-feet high:

2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

## 2.7 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade A: 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

Over 6 feet high:

Grade A: 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

Grade B: 2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

## 2.8 TOP RAIL

Provide a minimum of 1.660 inches O.D. pipe rails. Provide expansion couplings 6-inches long at each joint in top rails.

## 2.9 CENTER RAILS BETWEEN LINE POSTS

For fencing over 6-feet high, provide 1.660 inches O.D. pipe center rails, Grade B weighing 1.82 pounds per linear foot.

## 2.10 POST-BRACE ASSEMBLY

Provide bracing consisting of 1.660 inches O.D. pipe Grade A weighing 2.27 pounds per linear foot and 3/8 inch adjustable truss rods and turnbuckles.

## 2.11 TENSION WIRE

Provide galvanized wire, No. 7-gage, coiled spring wire, provided at the bottom of the fabric only. Provide zinc coating that weighs not less than 1.2 ounces per square foot.

## 2.12 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A116, ASTM A702 and ASTM F626.

### 2.13 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

### 2.14 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

### 2.15 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Up to 6-feet wide:

2.875 inch O.D. pipe Grade B weighing 4.64 pounds per linear foot.

### 2.16 GATES

For gate leaves over 6 feet high or 6 feet wide, provide perimeter gate frames of 1.90 inch O.D. pipe Grade B weighing 2.28 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

### 2.17 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A116, ASTM A702, ASTM F626, and be as specified:

Provide forged steel hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

## 2.18 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

## 2.19 WIRE TIES

Provide 16-gage galvanized steel wire for tying fabric to line posts, spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

Provide wire ties constructed of the same material as the fencing fabric. Provide accessories with polyvinyl (PVC) coatings similar to that specified for chain-link fabric or framework.

## PART 3 EXECUTION

Provide complete installation conforming to ASTM F567.

### 3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

### 3.2 POST INSTALLATION

Anchor posts to concrete slab with expansion anchors and to adjacent wall construction as appropriate to provide secure installation. 3.3 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

### 3.4 CENTER RAILS

Provide single piece center rails between posts set flush with posts on the fabric side, using special offset fittings where necessary.

### 3.5 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

### 3.6 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

### 3.7 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 1-1/2-inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

### 3.8 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

### 3.9 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

### 3.10 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

### 3.11 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

### 3.12 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

### 3.13 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

### 3.14 FENCE INSTALLATION

Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

#### 3.14.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feet on center. Provide gate posts spaced as necessary for size of gate openings.

Provide drawings showing location of gate, corner, end, and pull posts.

### 3.15 ACCESSORIES INSTALLATION

#### 3.15.1 Post Caps

Design post caps to accommodate top rail. Install post caps as recommended by the manufacturer.

### 3.16 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --